WHITE-NOSE SYNDROME
RESPONSE TEAM

Acceptable Management Practices for Rehabilitating Bats Affected by White-nose Syndrome

A Guide for Wildlife Rehabilitators

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Acceptable Management Practices for Rehabilitating Bats Affected by White-nose Syndrome

Introduction

The purpose of this document is to provide consistent Acceptable Management Practices (AMPs) for bat rehabilitators to reduce the risk of spreading *Pseudogymnoascus destructans* (*Pd*), the fungus that causes white-nose syndrome (WNS), and to increase awareness of WNS in the rehabilitator community. These guidelines were developed by wildlife rehabilitators, representatives from state and federal agencies, and private conservation organizations in response to catastrophic population declines of many bat species due to WNS. These AMPs are recommended for use in all rehabilitation facilities that may take in North American bat species, regardless of their conservation status.

Wildlife rehabilitators have been active partners with wildlife management agencies and researchers, which has led to advances in understanding WNS and its effects on bats. Rehabilitators provide information on geographic location of colonies, observations of health of local bat colonies, and disease progression. They are also an important voice for bat conservation to the public. Rehabilitators are encouraged to communicate with local, state and federal biologists to share these observations as well as obtain additional resources and information about bats and WNS.

This document provides recommendations to: 1) reduce the risk of spreading fungal pathogens between and among bats while in captivity; 2) reduce the potential for spreading *Pd* upon release of a bat from a facility; and 3) increase survival of WNS-affected bats. General background information is included on the significance of, threats to, and biology and behavior of bats to illustrate context and justification for these recommendations.

It is the responsibility of the rehabilitation facility to know and follow applicable state and federal laws related to the collection, movement, possession, and release of wildlife. Rehabilitators must have appropriate state and federal wildlife rehabilitation licenses and endangered/threatened species authorizations to handle and maintain bat species.

Background on White-nose Syndrome

White-nose syndrome (WNS) has caused unprecedented declines in hibernating bat populations in the United States and Canada since its discovery in 2007.

WNS is a fungal disease that has devastated populations of hibernating bats throughout eastern and central United States and Canada. It is caused by a cold-loving fungus, *Pseudogymnoascus*

destructans (*Pd*, formerly *Geomyces destructans*; Lorch et al. 2011; Minnis and Lindner 2013). *Pd* attacks exposed skin of bats while they hibernate. The fungus and the disease may be present without characteristic fungal growth or infection, which is often less obvious outside of hibernation sites.

WNS is confirmed by histopathological analyses conducted in a diagnostic lab to reveal characteristic lesions in skin tissue. Bats may still transport *Pd* on their skin and fur even if they do not exhibit the disease. (Diagnostic samples and swabs should only be collected from with prior authorization and instruction from the state wildlife management agency.)

WNS is spread primarily by bat-to-bat or environment-to-bat contact; however, *Pd* spores can survive on many surfaces, including clothing, gear, and equipment (Puechmaille et al. 2011b, Hoyt et al. 2014) suggesting that people can contribute to the spread. As of August 2018, WNS or the causative fungus has been documented in 37 states, 7 Canadian Provinces[1], and on 17 bat species[2] in North America.

Best available science indicates that *Pd* arrived in North America from a foreign source; both *Pd* and WNS have been documented throughout Eurasia (Hoyt et al. 2016; Puechmaille et al. 2011; Wibbelt et al, 2010). In North America, once *Pd* has been detected, either on bats or in the environment, the county of occurrence is considered contaminated indefinitely due to the long-term persistence of the fungus.

Management strategies to slow the spread of WNS include Recommendations for managing access to subterranean bat roosts to reduce the impacts of white-nose syndrome in bats[3] (2016) and National white-nose syndrome decontamination protocol[4] (2018).

Disease treatments and management strategies are currently in various stages of development with more research and coordination needed to address their safety and effectiveness. **For additional information about WNS, including up-to-date information on fungal spread, a list of affected species, management strategies, treatment, and fungal containment research updates, visit www.whitenosesyndrome.org.**

Bat Biology and Behavior: Signs of WNS

Information about seasonal bat behavior will help rehabilitators identify the time of year when signs of WNS infection are likely to be observed.

[1] Current WNS Spread Map - https://tinyurl.com/WNSSpreadMap
[2] Bat Species Affected by WNS - https://tinyurl.com/WNSSpecies
[3] Recommendations for managing access to subterranean bat roosts to reduce the impacts of white-nose syndrome in bats (2016) - https://tinyurl.com/WNSManagement
[4] National white-nose syndrome decontamination protocol (2018) - https://tinyurl.com/WNSDecontamination

Fall/Winter:

North American bats are predominately insectivorous. To survive a scarcity of food during winter, they either migrate to warmer climates where insect prey is available or hibernate.

In the fall, hibernating bat species go to hibernation sites where the climate is favorable and stable. Occasionally, long-distance migratory species may also use these sites throughout the year, thereby introducing the potential for non-hibernating species to encounter and transport the fungus.

While in hibernation, a bat's heart rate, respiratory rate, body temperature, and immune function decrease to conserve energy. WNS affects bats while they hibernate; the fungus invades their skin, resulting in dehydration, unrest, and increased activity (Lorch et al., 2011; Reeder et al., 2012). Sick bats often emerge from hibernation during winter and can be found flying during the day and dying on the ground. These bats may be collected live and submitted to rehabilitation facilities, resulting in the potential for *Pd* contamination and spread during transport and/or within rehabilitation facilities.

Winter observations of multiple dead bats at a single location or bats flying during the day should be reported to the local USFWS field office or State agency wildlife office.

Spring/Summer:

Bats that survive the winter in WNS-affected sites emerge in the spring and migrate back to their summer ranges. Bats can move hundreds of miles between winter roosts and summer roosts, potentially resulting in the natural transport of *Pd* over long distances.

A bat with WNS that survives to emerge in the spring may show signs of wing damage from *Pd* infection (Reichard and Kunz 2009; e.g. see cover photo). Some wing damage can heal naturally (Dobony et al. 2011; Fuller et al. 2011); however, severely affected individuals may need supportive care if brought into a rehabilitation facility. Even those bats that do not show outward, visual signs of infection may carry *Pd* throughout the summer (Langwig et al. 2015), presenting risk of transporting spores year-round.

While *Pd* has not been shown to cause WNS during the summer, bats brought into rehabilitation during warmer months could still carry the fungus (Dobony et al. 2011, USGS-NWHC unpublished data) and precautions for reducing the risk of spread remain important.

Colonies disband in late summer, as bats make their way to swarming sites, hibernacula, or winter roosts. Bats in the U.S. and Canada mate during the fall swarming period. Social interactions and use of previously contaminated sites at this time can reinfect bats with *Pd* and lead to development of WNS soon after (Langwig et al. 2015).

Species Identification:

Identifying bats to species can be challenging. Knowing which species are likely to occur in an area and which species are affected by WNS is essential. A few examples of regional species identification guides are in Appendix A. It is the rehabilitator's responsibility to know and follow applicable state and federal laws related to collection, movement, possession and release of wildlife. Appendix A also includes a list of bat species commonly encountered at rehabilitation facilities as well as bat species with a known susceptibility to WNS and the species' current (2017) federal listing status.

General Considerations

We recommend that rehabilitators prepare a strategy that includes considerations outlined in this document before accepting bats for rehabilitation, particularly within the endemic and intermediate areas (Figure 1).

Due to unique challenges of maintaining bats in captivity, rehabilitators should only accept bats if they are 1) experienced with them, and 2) have a basic knowledge about WNS and the appropriate level of precautionary measures necessary to house and care for them (taking into account their capture location in the WNS Management Areas identified in Figure 1). We urge rehabilitation facilities to develop a decontamination plan and train all personnel and volunteers before receiving bats. Bats should only be handled by trained and experienced caregivers who have received pre-exposure rabies vaccinations and carry an active titer for rabies. We also recommend obtaining access to veterinary care. At a minimum, rehabilitators should follow principles of wildlife rehabilitation outlined by the National Wildlife Rehabilitators Association (See Appendix C for additional resources).

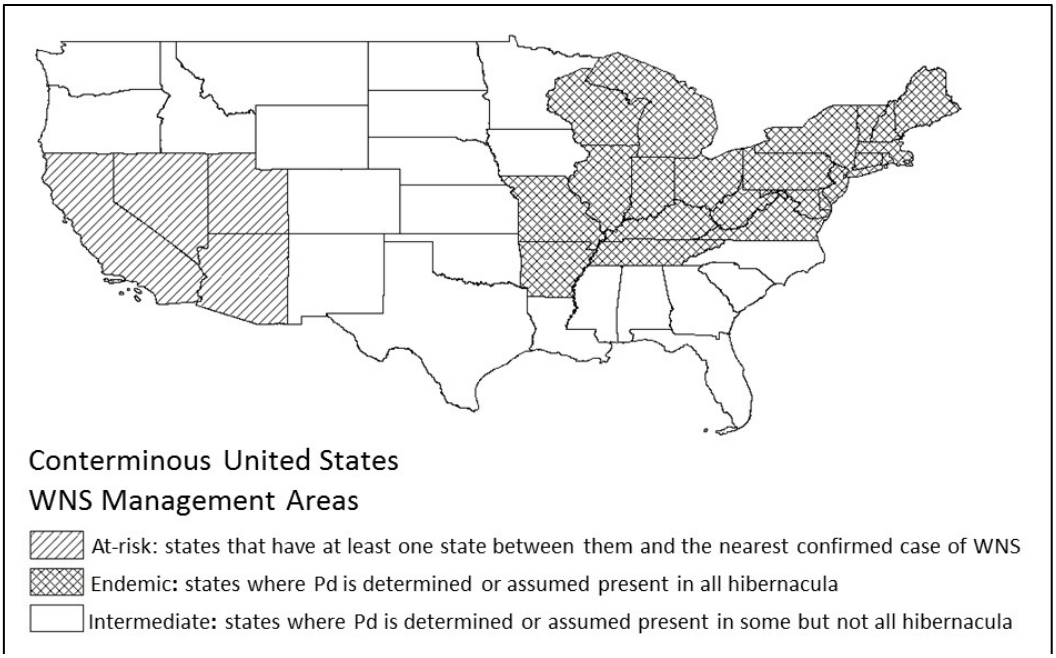

Figure 1. Conterminous United States WNS Management Areas, based on Pd and disease spread, and distribution as of August 2018

Decontamination for WNS

Decontamination is the primary management option available to reduce the risk of transmitting the fungus that causes WNS. It is vitally important for protection of bats and their habitats.

The current National Decontamination Protocol[4] focuses heavily on equipment used in research and in cave and mine habitats; however, rehabilitators should not underestimate the potential risk of fungal transfer associated with any bat-related work. Following the National Decontamination Protocol will reduce the risk of transmitting the fungus when conducting work involving close or direct contact with bats, their environments, and associated materials. See Appendix B for common equipment needing decontamination or disposal.

Choose equipment and procedures that promote the most effective decontamination strategy, keeping in mind that some decontamination methods are more suitable for items that bats come into close contact with than others (e.g. use hot water treatment rather than a chemical treatment for roosting cloths used inside bat enclosures). Equipment should always be inspected for defects before use. New equipment can be used at any facility, as long as it has not come in contact with bats or bat habitats, or been stored with used equipment used in the *Pd*-endemic and intermediate management areas. Equipment and supplies that contact a WNS-affected species (Appendix A) in the endemic and intermediate areas (Figure 1) including gloves, forceps, dishes, holding containers, etc. must be disposed of or decontaminated after use with each individual and before reuse. No equipment that is used in the endemic or intermediate zones should be used in the at-risk area, and it is recommended that all movement of equipment used with bats be avoided.

Consider using disposable supplies and materials whenever possible. All disposable items (e.g. exam gloves) should only be used on one bat, and then discarded after use. Re-useable supplies must be cleaned and decontaminated between individual bats using the most appropriate application or product identified in the National Decontamination Protocol. Some equipment commonly used in rehabilitation facilities may need to be cleaned according to the manufacturer's specifications and then be decontaminated following the National Decontamination Protocol, in accordance with the product label.

Preparation for rehabilitation of WNS-affected and susceptible bat species

For the benefit of bats and their habitats, compliance, whether mandatory or recommended, will ensure the most responsible approaches to bat rehabilitation are carried out.

Check with the appropriate local state wildlife agency or USFWS field office for current management regulations or requirements before accepting bats into rehabilitation. Some regulatory or land management agencies may have supplemental documents that provide

additional requirements or exemptions specific to rehabilitation of bat species under their jurisdiction.

The following recommendations are intended for wildlife rehabilitation specialists and facilities and should not be interpreted to relate to other possible encounters with bats such as scientific research, management, education, or any other activities.

Admission

Before accepting bats into a rehabilitation facility, identify the appropriate WNS Management Area (Figure 1) in which the facility is located to determine risk of receiving WNS-affected individuals. Due to uncertainties about knowing exactly where *Pd* is and is not present and where bats originated, it is advisable to treat all bats submitted for rehabilitation as potentially contaminated with the fungus.

Transport

Never encourage the public to handle live bats. Transporting live bats should only be conducted by trained and rabies-vaccinated rehabilitators and assistants. Hibernating or sick bats often appear moribund or dead and may be captured easily, but this does not lessen the need to take proper precautions to ensure the safety of people and the bat. Always use personal protective equipment, including gloves, to safely handle and transport a bat. Use containers for holding and transport that are breathable, secure (i.e. bat cannot get out), and washable or disposable. Double escape-proof containment should be used for transport, (i.e. a travel container within a larger container, such as a plastic tote with lid and air holes; zippered canvas bag) before placing them into a vehicle to reduce the potential risk of *Pd* transfer to the inside of a vehicle. Holding and transport containers that have been used for WNS-affected species (Appendix A), within WNS endemic or intermediate management areas should never be reused for: 1) unaffected species; 2) outside of the range of WNS; or 3) non-releasable bats (such as those used in education programs).

Know and follow applicable state and federal laws, and associated permitting requirements or prohibitions, related to the movement and possession of wildlife. Always obtain state and USFWS permits before conducting the proposed activity, if required.

Bat housing and handling, including quarantine

Contact the local state wildlife agency or USFWS field office for state-specific guidelines relating to the intake and rehabilitation of WNS or *Pd*-positive bats. Bats should only be admitted to rehabilitation facilities that are equipped to house and care for them. In the endemic and intermediate areas (Figure 1), where *Pd* is known to be present, rehabilitators should isolate wild bats, ideally in quarantine rooms, but at a minimum, house them separately in a designated area away from other animals and any non-releasable bats in the rehabilitation

facility. All bats and equipment in a quarantine room or area should be considered exposed to *Pd.* Areas designated for quarantine should have non-porous surfaces, walls, and equipment that can be cleaned and disinfected according to the national decontamination protocol. If non-releasable bats are housed at the rehabilitation facility, they must be handled before handling any wild and/or WNS-affected individuals; maintain a second set of equipment and materials to be used only for non-releasable bats to further isolate those individuals from potential risk of infection by *Pd*.

To reduce the risk of transmitting *Pd* and other microbes among individuals and colonies, bats should be housed according to intake location and season. Bats found on the ground during the winter or early spring, when they would have a high chance of coming into contact with the fungus, should be housed separately from bats found at other times of the year however, multiple individuals found in the same county and season can be housed together.

Field studies indicate that some individuals have been able to recover from WNS without rehabilitation and survive subsequent exposure and infection (Dobony et al. 2011; Fuller et al. 2011; Reichard et al. 2014). To help with healing and discourage *Pd* growth, we recommend that WNS-affected individuals are maintained in a euthermic state and provided with basic supportive care (i.e. warmth, food, and water; Meteyer et al. 2011).

The amount of *Pd* on a bat can affect the level of infection and disease progression in the future (Langwig et al. 2015); therefore, precautions should be taken to avoid transferring fungus among individuals. Dedicated or disposable aprons, lab coats, gloves, and shoe coverings should be worn while working with animals in quarantine. Non-disposable items should be laundered and decontaminated according to current national decontamination protocols. Supplies used with quarantined individuals should only be used in the quarantine area, even after proper decontamination.

Species affected by WNS[2] (Appendix A) should be closely monitored in rehabilitation because WNS signs can develop rapidly and bats can deteriorate quickly. Bats that have WNS often show damage and deterioration of their wing membranes (Reichard and Kunz, 2009) as their immune systems upregulate and attempt to clear the *Pd* infection (Meteyer et al 2012). This damage generally becomes apparent a few days to a week after a bat has aroused from hibernation and can look like the bat's wings are dry, crusty, or generally falling apart. Rehabilitators are encouraged to record a wing score and photograph bat wings for 2-3 weeks to track this immune response and subsequent healing according to the Wing Damage Index[5].

Unless involved in a specific research project, or operating under the direct advisement of a veterinarian, do not attempt to use any anti-fungal treatments on bats in rehabilitation because effects of these chemicals on bats remain unknown and could be detrimental. Record

[5] Wing Damage Index - https://tinyurl.com/WNSWingDamageIndex

all information required by local state wildlife agency or USFWS field office in accordance with permits and other instructions provided by that agency.

Release or Euthanasia

Contact the local state wildlife agency or USFWS field office for any applicable exemptions, requirements regarding specific quarantine timelines, or other state-specific guidelines relating to the release or euthanasia of WNS or *Pd*-positive bats.

If a rehabilitation facility receives a bat of any species showing signs of WNS infection or an admitted bat develops unusual wing damage during winter or spring, contact the state agency biologist and/or local USFWS field office for additional information and instructions for potential submission of diagnostic samples for testing.

Ensure that bats exhibiting wing damage because of WNS infection are fully healed and capable of flight before release. Ideally, rehabilitators should have two flight cages, allowing one to be dedicated to WNS-affected individuals and species, and another cage for all others. If only one flight cage is available, at a minimum, bats that are suspected or confirmed to be WNS or *Pd* positive should be flown separately from unaffected species. Always allow unaffected species access to the flight cage before affected species, and decontaminate flight enclosures after WNS-affected bats are flown, or at a minimum, decontaminate all surfaces upon which bats land, to the extent practicable.

Release bats within one mile of their initial point of capture, or at most within the county of capture, to prevent unintentional spread of spores and to allow the bat to continue in its familiar and native range.

For bats determined non-releasable, consult the appropriate permitting authority or contact the local state wildlife agency or USFWS field office for additional requirements or instructions. Humane euthanasia methods must conform to all relevant state and federal permits and regulations. Appendix C has references on humane euthanasia guidelines for insectivorous bats.

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Appendices

Note: The information provided in these Appendices is not exhaustive and is for informational purposes only. Accuracy of the information included on the sites provided is the sole responsibility of the site owner. Inclusion does not imply endorsement by the federal government.

Appendix A: Bat Species Information:

State agencies should adapt this document for their needs by filling in the following table and resources list with information regarding bat species in their state (include additional headings as needed) before distribution within their state.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	RANGE	TYPICAL WINTER ROOSTING BEHAVIOR	TYPICAL SUMMER ROOSTING BEHAVIOR	WNS CONFIRMED/ SUSCEPTIBLE	FEDERAL T&E STATUS (Year updated)	STATE T&E STATUS (Year updated)
EXAMPLE for VERMONT: Little brown bat	*Myotis lucifugus*	State-wide	Hibernates in Caves/ Abandoned Mines	Commonly roosts in attics, barns, churches, and other bat houses	Confirmed, Significant declines due to WNS	Not Listed	Endangered (2014)

North American Bats Table of WNS and Protection Status (October 2016) - https://tinyurl.com/WNSCRWGProducts

Resources for species identification - Online

- **Ball State University, Tim Carter**
  Field Identification Sheets for Eastern Bats - https://tinyurl.com/TCarterHowTo
- **Bat Conservation International**
  Bat Species Profiles: http://tinyurl.com/BCIBatProfiles
- **Bat Survey Solutions**
  US Eastern Bats: A Dichotomous Key - https://tinyurl.com/EastBatKey
- **Colorado State University**
  Colorado Bat Matrix: Bats of Colorado - https://tinyurl.com/COBatSpecies
- **Maryland Department of Natural Resources**
  Maryland Bat Identification Dichotomous Key - https://tinyurl.com/MDBatID
- **Oklahoma Department of Wildlife Conservation**
  Bats of Oklahoma Field Guide - https://tinyurl.com/OKBatGuide
- **State of Montana**
  Montana Field Guide: Bats - https://tinyurl.com/MTBatGuide
- **Vermont Fish and Wildlife Department**
  Got Bats? - http://www.vtfishandwildlife.com/gotbats.html

Resources for species identification - Books

Harvey, M.J., S. Altenbach, and T.L. Best. 2013. Bats of the United States and Canada. 224pp. JHU press. ISBN 9781421403007.

Mies, R. 2017. Bats of Western North American: A Comprehensive Guide to All Species. 12pp. Quick Reference Publishing, Inc

Williams, K., D. Stokes, L. Stokes, and R. Mies. 2002. Stokes Beginner's Guide to Bats. 160pp. Little, Brown, and Company. ISBN 9780316816588.

Appendix B: Decontamination

Follow the latest decontamination protocols for WNS, found at www.whitenosesyndrome.org

The following table lists some typical equipment used in rehabilitation facilities that could transport fungal spores between/among bats and/or sites. Keep in mind that this is not a complete list.

Rehabilitation Equipment Category	***Items Typically Used Include:***	***Comment***
Disposable personal protective equipment	Latex or nitrile gloves, Tyvek suit, paper robe, gloves, booties	Disposable items may be used in areas where WNS-affected species are handled, such as in the quarantine room. These items can be double bagged, sprayed with appropriate disinfectant, and disposed of in the trash.
Non-disposable equipment	Cages, transportation containers, cloths, towels, roosting structures, bowls, enrichment items, feeding tools, leather gloves, forceps, feeding dishes, bedding, oral syringes for medication administration	Decontaminate following WNS guidelines.

Appendix C: Additional Resources for Care and Rehabilitation of Bats

- Information about white-nose syndrome: www.whitenosesyndrome.org
- National wildlife Rehabilitators Association: http://www.nwrawildlife.org
- Wildcare Australia Inc. Introduction to the Care and Rehabilitation of Microbats: http://tinyurl.com/AUBatRehab
- The Wildlife Center of Virginia: Wildlife Incident Log/Database and Online Network Database: http://wildlifecenter.org/wild-one
- Basically Bats Wildlife Conservation Society, Inc.: Rehabilitating Bats with White-Nose Syndrome: http://tinyurl.com/Bats101Rehab
- American Veterinary Medical Association Guideline for the Euthanasia of Animals (2013): http://tinyurl.com/AVMAEuthanasia
- Bat World Sanctuary Insectivorous Bat Euthanasia: http://tinyurl.com/BatWorldEuthanasia

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