WYOMING GAME & FISH DEPARTMENT

A Strategic Plan for White-nose Syndrome in Wyoming

Hibernating Townsend's big-eared bat, Washakie County, Wyoming. Photo by S. Johnson. 2009.

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INTRODUCTION

Cave and abandoned mine-hibernating bats across North America are at risk of contracting a fungus that is causing major declines in bat populations in the Eastern U.S., namely, white-nose syndrome (WNS). WNS is named after a conspicuous white fungus, *Geomyces destructans,* which invades and erodes the skin of hibernating bats. The fungus causes hibernating bats to arouse more frequently and deplete fat stores more rapidly. *G. destructans* growth causes a loss of dermal integrity and disrupts the skin's regulatory properties for fluid balance. Bats particularly susceptible to WNS are species that are sensitive to evaporative water loss during hibernation (e.g., *Myotis lucifugus, M. septentrionalis,* and *Perimyotis subflavus*) (Cryan *et al*. 2010). WNS-affected bats are known to leave hibernacula mid-day during winter presumably to forage or drink, and to roost in unusual areas of the hibernacula. While the ultimate cause of death in bats is *G. destructans* infection, proximal causes of death as a result of infection include starvation, dehydration, and exposure to cold temperatures. Updated information on signs of *G. destructans* infection and WNS symptoms is available at http://whitenosesyndrome.org/.

Three species of bats have tested positive for *G. destructans* infection but have not exhibited the symptoms of WNS (Table 1). *G. destructans* was reported on a live *Myotis velifer* in northwestern Oklahoma in the spring of 2010. Not only does this mark the western-most occurrence of the fungus, it marks the first known occurrence of *G. destructans* in a western bat species (BCI 2010). *M. velifer* are known to share roosts with *Tadarida brasiliensis,* a wide-ranging, migratory species (BCI 2010). The potential for *T. brasiliensis* to act as a vector for spreading *G. destructans* further west and south is unknown at this time.

Table 1. North American bat species that have been affected by WNS and those on which *G. destructans* has been detected (USFWS). Status of bats in Wyoming includes Non-Resident (NR), Resident (R), and Accidental (A).

	Species	Common name	Wyoming status
WNS fatalities	*Eptesicus fuscus*	Big brown bat	R
	Myotis leibii	Eastern small-footed bat	NR
	M. sodalis	Indiana bat	NR
	M. lucifugus	Little brown bat	R
	M. septentrionalis	Northern long-eared bat	R
	Perimyotis subflavus	Tricolored bat	A
G. destructans detected	*M. velifer*	Cave bat	NR
	M. grisescens	Gray bat	NR
	M. austroriparius	Southeastern bat	NR

Three geographic regions were established to facilitate nationwide WNS management responses (Szymanski *et al.* 2009). Area 1 is the epicenter of WNS, where the presence of *G. destructans* and WNS was first documented and is the most prevalent. Area 2 is the leading edge of *G. destructans* and WNS, the area that has a combination of affected and unaffected sites. Area 3 is the area that includes caves and mines that are currently unaffected by WNS but are potentially susceptible (Fig. 1). Area 3 is delineated as being 250 miles or more from the most recent occurrence of WNS (Szymanski *et al.* 2009). It is important to note that the boundaries of these three areas are dynamic and they will likely change over time. Wyoming is currently located within Area 3 and by definition does not yet have WNS-affected sites. Management in Wyoming should focus on gathering baseline data on bat populations, detecting new occurrences of WNS, monitoring the proximity of affected sites, and preventing the spread of the fungus into Wyoming.

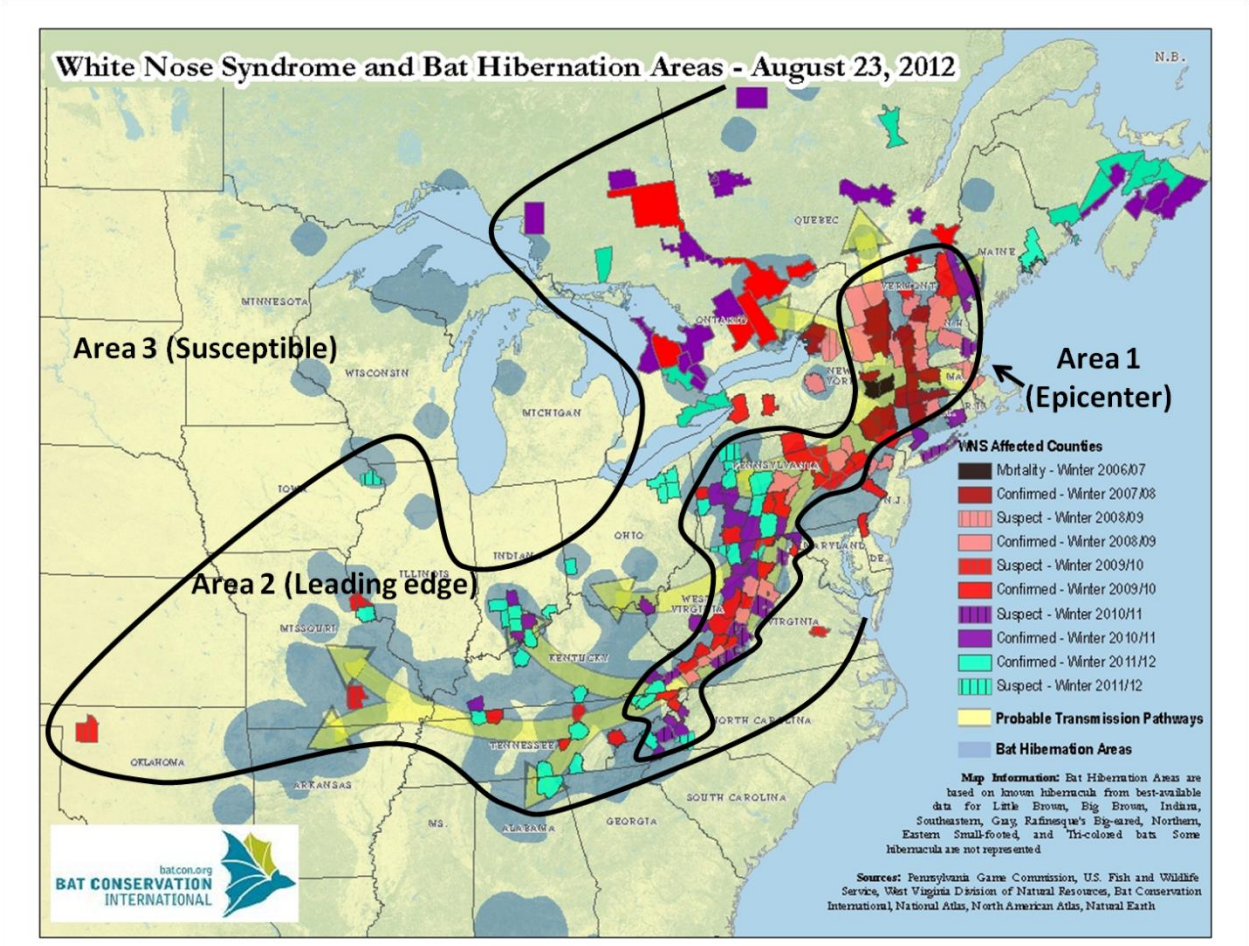

Figure 1. Current estimated locations of WNS Areas 1, 2, and 3 in eastern North America, 2012. Map adapted from Bat Conservation International and Szymansky *et al.* (2009).

Many western states are establishing WNS response plans as a precautionary measure to guide management activities should WNS continue to spread. The overarching objective for states within Area 3 is to prevent the arrival of WNS by controlling the transmission of WNS from affected sites. The nearest occurrence of *G. destructans* to Wyoming is western Oklahoma, about 400 miles from Wyoming's southeast corner. The nearest occurrence of WNS is eastern Missouri, about 730 miles from the southeastern border of Wyoming.

PURPOSE

The Wyoming Bat Working Group (WYBWG) recognizes that WNS and *Geomyces destructans* may continue spreading in the near future and the group is concerned about potential impacts to local bat populations. This document is intended to assist decision makers in coordinating a statewide response to this threat by documenting the need to establish systematic monitoring of bats throughout Wyoming, with recommendations on standardized survey

methodology and establishing criteria for guiding management responses in Wyoming. Implementation of these guidelines will improve our ability to minimize the spread of *G. destructans* and WNS to bat populations in Wyoming.

PLAN DEVELOPMENT AND MAINTENANCE

Wyoming Game and Fish Department (WGFD), via the Western Bat Working Group (WBWG), and WYBWG will work in coordination with other agencies and Non-Governmental Organizations (NGOs) to create a feasible response strategy to WNS and *G. destructans* for the state of Wyoming. The first phase of this plan will be implemented immediately, while subsequent phases are to be implemented as needs arise and threats to populations of bats in Wyoming increase (i.e., as *G. destructans* and WNS spreads further west). This plan should be updated as new information about WNS becomes available or as threats change.

SITUATION AND ASSUMPTIONS

WNS and *G. destructans* may continue spreading west in the near future. Strategic planning will facilitate management responses, increase public and agency awareness, and attempt to minimize the risk of spread of *G. destructans* via human activities to bat habitat in Wyoming. There are 18 species of bats found in Wyoming, 11 of which are residents classified as Species of Greatest Conservation Need by WGFD. Bats are found throughout the state and constitute 15% of all Wyoming's mammalian species, thus contributing extensively to Wyoming's biological diversity.

As the primary predator of nocturnal insects, bats play an essential role in regulating insect populations and insect-related ecological processes. Additionally, many insects consumed by bats are among North America's most costly agricultural and forest pests. WNS-infected bats display 90-100% mortality rates, and some bat populations in Area 1 are 5% of what they once were. Given the "slow" life history of bats (i.e., low fecundity rate, high life expectancy), it is likely that some populations of some bat species may never fully recover from these drastic declines within our lifetimes.

WGFD began conducting cave and abandoned mine surveys throughout the state from 1994 to 1997, providing baseline roost distribution and abundance for bats in Wyoming. Bat inventories in forests of Wyoming were conducted during the summers of 2008-2011. In 2012, an inventory of cliffs, canyons, caves, and rock outcrop habitats was initiated to document species of bats that occur in these habitats. Research and reported mortalities suggest that *M. lucifugus, M. septentrionalis* and *P. subflavus* are particularly vulnerable to WNS. Although *M. septentrionalis* and *P. subflavus* are rare in Wyoming, *M. lucifugus* is the most commonly captured and reported bat species in the state. There are 88 known *M. lucifugus* roosts in

Wyoming, with seven supporting > 50 individuals. There are four known *M. lucifugus* maternity roosts in the western part of the state supporting >100 individuals. Known hibernacula in the state are small and are located in north-central and southeast Wyoming (Table 2).

Table 2. Roost types and utilization by *M. lucifugus* in Wyoming. The majority of roosts are smaller than the reported means.

Roost type	n	Mean # MYLU (SE)	Range
Day Roost	14	5.7 (1.8)	1 - 24
Hibernacula	8	8.0 (3.6)	1 - 28
Maternity Roost	38	88.4 (46.4)	1 - 1,500
Night Roost	28	23.6 (17.7)	1 - 500
All Roosts	88	47.3 (21.0)	1 - 1,500

Caves and abandoned mines in Wyoming support relatively small bat populations when compared to caves and abandoned mines in eastern North America. For example, Pennsylvania caves and abandoned mines support bat populations that are orders of magnitude larger than bat populations in roosts in Wyoming. In addition to significant *M. lucifugus* roosts, other roosts in the state support large colonies of *Corynorhinus townsendii*. However it is unclear whether *C. townsendii* is susceptible to *G. destructans* and WNS. It is currently unknown whether conditions inside caves and abandoned mines in Wyoming are different from those in eastern North America and if they are favorable for *G. destructans* growth.

- WNS is spreading west in North America
- As of winter 2010/2011, *G. destructans* has spread to western Oklahoma, 400 miles from the Wyoming border
- As of winter 2011/2012, WNS has spread to eastern Missouri, 730 miles from southeastern Wyoming border
- The high mortality rate in WNS-affected bats coupled with bats' slow life history make it likely that bat populations will not recover to their pre-WNS levels in our lifetime
- Six species of cave-hibernating bats have been affected by WNS, four of those species are known to occur at some level in Wyoming: *Myotis lucifugus, M. septentrionalis, Eptesicus fuscus,* and *Perimyotis subflavus*
- Baseline capture and acoustic data in Wyoming show that *M. lucifugus* is the most commonly observed bat in Wyoming
- There are 88 known *M. lucifugus* roosts in Wyoming, however roost populations are small in comparison to roosts in eastern North America

- It is not known whether conditions inside Wyoming caves and abandoned mines are favorable for *G. destructans* growth, or if Wyoming bat populations are susceptible to WNS as those of eastern North America.

OPERATIONAL FRAMEWORK

We recognize that many biological conditions in hibernacula in Wyoming differ from those within the epicenter. For example, roost size, species composition, and habitats are different; therefore, currently it is impossible to predict the impacts, or lack thereof, WNS and *G. destructans* will have on bat populations in Wyoming. Our understanding of the dynamics of this new threat is limited and continuously evolving, but this does not reduce the need to address this conservation challenge in Wyoming. We believe that by being proactive managers in Wyoming we will be better equipped to respond to this threat.

We have established a 250 mile buffer surrounding the state to trigger WNS Management Response Stages (MaRS), based on the location of the nearest *G. destructans* detection or WNS occurrence. Three stages have been developed for Wyoming: MaRS 1, the nearest *G. destructans*/WNS detection is greater than 250 miles from the Wyoming border; MaRS 2, *G. destructans*/WNS is detected less than 250 miles from the Wyoming border; and MaRS 3, *G. destructans*/WNS is detected within the state of Wyoming (Fig. 2). Since the nearest detection of *G. destructans* to the state of Wyoming was in western Oklahoma, MaRS 1 will be implemented immediately.

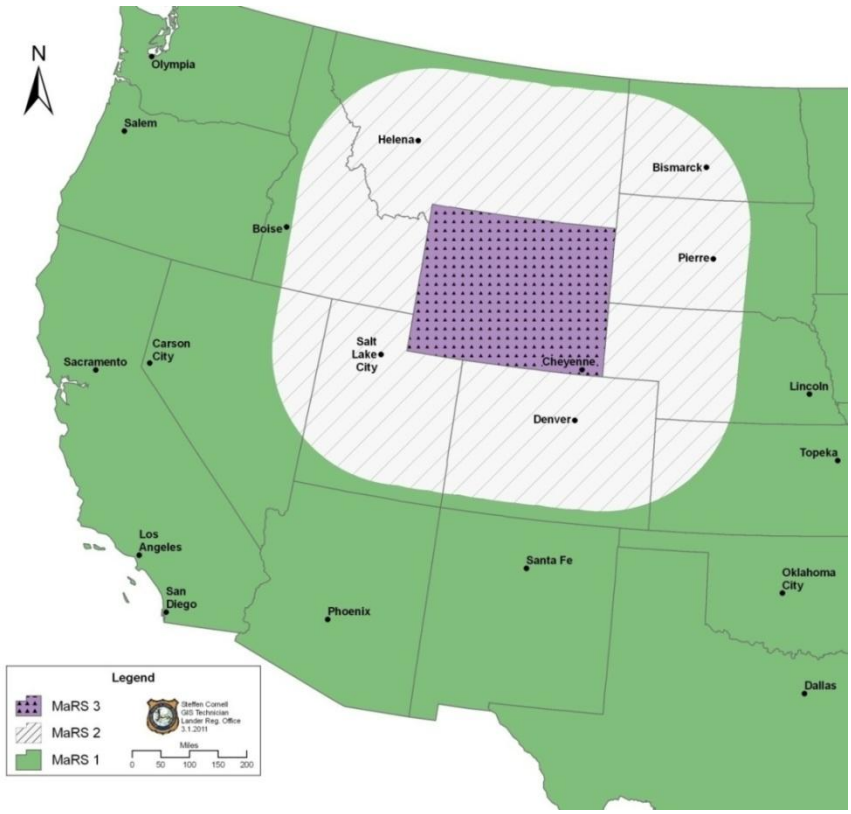

Figure 2. Management Response Stages (MaRS) 1, 2, and 3 for White-Nose Syndrome in Wyoming.

Programmatic objectives that have been identified under each MaRS reflect the purpose and intent of this plan. Each of these objectives identifies specific strategies that must be addressed to attain desired outcomes. Strategies identified during each stage will continue to be implemented in each subsequent stage; new strategies that reflect changes in threats to bats in Wyoming will also be implemented. Specific decontamination protocols are presented for each MaRS in Appendices 2-4.

MANAGEMENT RESPONSE STAGE 1 – (MaRS 1)

MaRS 1 is currently being implemented in Wyoming because the nearest *G. destructans* and WNS occurrence is > 250 miles from the state border. The guiding principles for MaRS 1 are to monitor the proximity of WNS and *G. destructans* while establishing baselines and building capacity to respond to changes in threats in Wyoming.

A. TIMELINE

Objective I: Implement the following objectives and strategies immediately.

B. COORDINATION

Objective I: Develop a central point of contact to facilitate coordination and implementation of this plan.

Strategies:

(1) The WGFD Nongame Mammal Biologist will serve as the state WNS coordinator and will be responsible for ensuring that objectives within this plan are implemented.

Objective II: Review and disseminate information among agencies (e.g., WGFD, US Forest Service, Bureau of Land Management, etc.), NGOs (e.g., WBWG, WYBWG, etc.), and the public.

Strategies:

(1) Annually an executive summary will be submitted by the Nongame Mammal Biologist to lead contacts of interested parties. Lead contacts will be agency administrators or equivalent in NGOs and they will disseminate information to the field personnel. The report will highlight on-going activities, new developments, objectives being implemented, and management recommendations for Wyoming.

(2) Coordinate with agencies to ensure that management actions are consistent with and correspond to the appropriate threat level, as identified in this plan.

C. DETECTION

Objective I: Implement survey and reporting standards that will facilitate the detection of WNS or *G. destructans* in Wyoming.

Strategies:

(1) Ensure that all personnel capturing and handling bats in Wyoming are able to recognize symptoms (e.g., wing damage) properly and that all handled bats are screened using the Reichard wing damage index (WDI) and other screening methods that become available (Refer to APPENDIX 5: Useful WNS links).

(2) Revise the language of the WGFD Chapter 33 Scientific Collection Permit to ensure that all personnel requesting to capture bats in Wyoming receive additional information about WNS symptoms, a copy of the WDI (Refer to APPENDIX 5: Useful WNS links), and reporting procedures for suspected bats (Refer to APPENDIX 1).

(3) Revise the recommended survey sheets in the Conservation Plan for Bats in Wyoming to include a way to record WDI.

Objective II: Implement a strategy for effectively detecting the arrival of *G. destructans* and WNS in Wyoming.

Strategies:

(1) Review, summarize, and classify all existing data for all roosts and all species.

(2) Develop criteria and a prioritization system for selecting roosts that are most vulnerable to this threat (e.g., hibernacula vs. night roost, *Myotis lucifugus* vs. *Corynorhinus townsendii*, large vs. small, etc.). These should be classified as Primary Priority Roosts (PPR), Secondary Priority Roosts (SPR), and Tertiary Priority Roost (TPR) to reflect conservation priority.

(3) Utilize the results from Strategy 1 & 2 to develop detection and monitoring recommendations for all MaRS (Refer to APPENDIX 2-4).

(4) Pursue funding opportunities to implement monitoring recommendations at all levels.

(5) Participating agencies will annually assist in the compilation of statewide

monitoring efforts to be subsequently summarized and transmitted by the Nongame Mammal Biologist to the partner agencies.

D. PREVENTION

Objective I: Review, implement, and promote existing outreach efforts aimed at preventing the spread of WNS and *G. destructans* via human activities.

Strategies:

(1) Review and revise all existing products (e.g., decontamination protocols, awareness signs, etc.) and develop products that are consistent with objectives and threat levels for Wyoming.

(2) Revise the language of the WGFD Chapter 33 Scientific Collection Permit to ensure that all personnel requesting to capture bats in Wyoming receive additional information about WNS symptoms and guidance on approved decontamination procedures for Wyoming (Refer to APPENDIX 1).

(3) Utilize existing resources (e.g., WBWG, WNS Steering Committee, etc.) and products they've developed whenever possible.

Objective II: Minimize the risk to Primary Priority Roosts

Strategies:

(1) Utilize the Bureau of Land Management, U. S. Forest Service, and National Park Service, as appropriate, to disseminate Wyoming specific protocols to the caving community via the existing cave access request process.

(2) Post WNS awareness signs at the entrance of high traffic caves. Signs should also discourage entry of the cave if the visitor is using gear or clothing that have been used in caves within WNS National Areas 1 and 2 (Szymanski *et al.* 2009).

(3) For known bat roosts that are not gated, discourage unnecessary entry, particularly when bats are present.

(4) Identify roosts that require gates and pursue opportunities to gate them.

E. EDUCATION AND OUTREACH

Objective I: Cooperate with existing media venues (e.g., WGFD Information and Publications Branch) and outreach efforts (e.g., WBWG website) to promote and disseminate information to the public and other interested parties.

Strategies:

(1) Develop a press release announcing the completion of this plan and implications of WNS in Wyoming.

(2) Cooperate with the WBWG to develop a WNS section of the Wyoming Bat Work Group website to facilitate dissemination of materials to the public and professional community.

(3) Cooperate with the WGFD to create a WNS link where additional Wyoming specific resources could be posted and referenced.

(4) Develop a WNS awareness presentation for the public, pursue opportunities to make public presentations, and post it on website.

(5) Develop and publish a WNS awareness brochure and disseminate to all agencies for public consumption.

(6) Chapter 33 Scientific Collection Permit for disseminating WNS information to research groups

(7) Cooperate with the U.S. Fish and Wildlife Service to create a link on the national WNS website that will direct interested parties to Wyoming specific information, including this plan

MANAGEMENT RESPONSE STAGE 2 – (MaRS 2)

After confirmation of WNS or detection of *G. destructans* within 250 miles of Wyoming borders, objectives in this section are to be implemented in addition to all objectives identified under MaRS 1. The guiding principles for MaRS 2 are to increase frequency of coordination and communication, identify high priority sites aimed at focusing detection and prevention efforts, and revise permits and protocols to reflect the new threat level.

A. TIMELINE

Objective I: After confirmation of detection within 250 miles of Wyoming, implement the following objectives and strategies within the next 6 months.

B. COORDINATION

Objective I: Increase frequency of coordination efforts.

Strategies:

(1) Prepare and disseminate executive summary to agencies quarterly.

(2) Implement semi-annual statewide conference calls with participating agencies and NGOs to facilitate implementation of the objectives under MaRS 2

(3) Notify all interested parties in the State that threat level has increased and the anticipated resulting changes in actions that will be implemented.

C. DETECTION

Objective I: Implement targeted surveys at PPR roost sites to facilitate the detection of WNS or *G. destructans* in Wyoming.

Strategies:

(1) Secure funding for sustaining these survey events.

(2) Select a subset of PPR roost sites for targeted surveys (e.g., abundance, population health, substrate, etc.).

D. PREVENTION

Objective I: Minimize the risk to all PPR roost sites.

Strategies:

(1) Create and disseminate a list of caves and abandoned mines that are not used by bats; utilize this list to redirect recreational pressure.

(2) Close all PPR roosts that are caves and are gated year-round to all recreational activities.

Objective II: Minimize the risk to PPR and SPR caves that are not gated but are utilized by bats.

Strategies:

(1) Implement a voluntary restriction on access; Exceptions shall include only approved activities such as research and monitoring.

(2) Pursue opportunities to implement and enforce more restrictive management options.

(3) Identify timeframes and hurdles that may preclude implementation or enforcement of more restrictive measures.

Objective III: Ensure that protocols that are disseminated are consistent with the new level of threat prevention.

Strategies:

(1) Coordinate with the WGFD permitting officer to ensure that updated information (e.g., decontamination protocols, etc.) is disseminated via the Chapter 33 Scientific Collection Permit (Refer to APPENDIX 3: MaRS 2 Protocol for decontaminating field equipment when conducting capture surveys for bats in Wyoming).

E. EDUCATION AND OUTREACH

Objective I: Expand outreach efforts to reflect new threat levels.

Strategies:

(1) Cooperate with existing media venues (e.g., WGFD Information and Publications Branch) and outreach efforts (e.g., WBWG website) to develop a WNS special press release for Wyoming.

MANAGEMENT RESPONSE STAGE 3 – (MaRS 3)

After confirmation of WNS or *G. destructans* detection within the state of Wyoming, objectives in this section are to be implemented in addition to all objectives identified under MaRS 1 and MaRS 2. The guiding principles for MaRS 3 are to increase coordination and communication, expand detection and prevention efforts, and revise permits and protocols to reflect the new threat level.

A. TIMELINE

Objective I: After confirmation of detection within Wyoming, implement the proceeding objectives and strategies within the next 2 months.

B. COORDINATION

Objective I: Increase frequency of coordination efforts

Strategies:

(1) Initiate a statewide notification call to participating agencies and NGOs within 2 weeks of detection in Wyoming.

(2) Implement quarterly statewide conference calls with interested parties to facilitate implementation of the objectives under MaRS 3

(3) Notify all interested parties in the State that threat level has increased and the anticipated resulting changes in actions that will be implemented.

C. DETECTION

Objective I: Broaden surveys of roosts to include SPR roosts

Strategies:

(1) Select additional PPR and SPR roosts to target for expanding detection efforts.

D. PREVENTION

Objective I: Minimize risk of cross-contamination between roosts.

Strategies:

(1) Restrict roost visitations by all personnel and for all reasons.

(2) Limit monitoring activities to exterior or portal visitations only.

(3) Discontinue entry of affected roosts for a minimum of 3 years.

Objective II: Ensure that protocols which are disseminated are consistent with the new level of threat prevention.

Strategies:

(1) Coordinate with the WGFD permitting officer to ensure that updated information (e.g., decontamination protocols, etc.) is disseminated via the Chapter 33 Scientific Collection Permit (Refer to APPENDIX 4: MaRS 3 Protocol for decontaminating field equipment when conducting capture surveys for bats in Wyoming).

E. EDUCATION AND OUTREACH

Objective I: Expand outreach efforts to reflect new threat levels.

Strategies:

(1) Cooperate with existing media venues (e.g., WGFD Information and Publications Branch) and outreach efforts (e.g., WBWG website) to develop a WNS special press release for Wyoming.

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APPENDIX 1.

Guidelines for Collection and Submission of WNS Data for Spring-Summer-Fall capture surveys

Document all occurrences of WNS and *G. destructans* with photographs and voucher specimens. Please refer to proceeding instructions on submission of voucher specimens and photographs. Photographs should be taken for all suspected occurrences, while voucher specimens need only be taken if one or both conditions apply:

- ☐ A WNS-susceptible bat species (Table 1) displays suspicious fungal lesions or depigmentation on wing membranes May-June (Reichard Wing Damage Index ≥ 2)

- ☐ A hibernating bat species with unknown susceptibility to WNS displays suspicious fungal lesions or depigmentation on wing membranes May-June (Reichard Wing Damage Index ≥ 2)

NOTE: Bats with wing damage captured after June have been found negative for *G. destructans* (NWHC 2010); therefore, the WGFD will not require voucher specimens after June. Refer to APPENDIX 5: Useful WNS links.

Table A1. Bat species that have been affected by WNS and those on which *G. destructans* has been detected (USFWS). Highly susceptible bats include *Myotis lucifugus*, *M. septentrionalis* and *Perimyotis subflavus*. Status of bats includes Resident (R), Peripheral (P), and Accidental (A).

Wyoming bat Species	Common name	WNS Susceptibility	Status
Eptesicus fuscus	Big brown bat	**Moderate**	R
Myotis lucifugus	Little brown myotis	**High**	R
M. septentrionalis	Northern long-eared myotis	**High**	R
M. ciliolabrum	Western small-footed myotis	Unk	R
M. evotis	Long-eared myotis	Unk	R
M. thysanodes	Fringed myotis	Unk	R
M. volans	Long-legged myotis	Unk	R
M. californicus	California myotis	Unk	P
M. yumanensis	Yuma myotis	Unk	P
Perimyotis subflavus	Tri-colored bat	**High**	A
Lasiurus cinereus	Hoary bat	Unk	R
L. borealis	Eastern red bat	Unk	P
Lasionycteris noctivagans	Silver-haired bat	Unk	R
Euderma maculatum	Spotted bat	Unk	R
Corynorhinus townsendii	Townsend's big-eared bat	Unk	R
Antrzous pallidus	Pallid bat	Unk	R
Tadarida brasiliensis	Brazilian free-tailed bat	Unk	P
Nyctinomops macrotis	Big free-tailed bat	Unk	A

APPENDIX 1, Continued.

Instructions for data collection and shipment of specimens

1. Record the following information and place in bag with each specimen:
   - ☐ Date collected
   - ☐ Location (Lat/long, UTM, etc.)
   - ☐ Collector(s) (name, address, phone)
   - ☐ Species
   - ☐ Found dead or euthanized (method of euthanization)
   - ☐ Unique reference # to match any photos taken

2. Place each carcass in its own plastic bag; close and seal the bag with tape. If more than one specimen, place all bagged specimens inside a second bag and seal. Mark the second bag with:
   - ☐ Number of animals and species
   - ☐ Date
   - ☐ Location (Lat/long, UTM, etc.)
   - ☐ Collector(s) (name, address, phone)

3. Line a hard-sided cooler with a third plastic bag and place absorbent material inside

4. Place enough frozen ice packs (sealed) inside the third bag to keep the carcass cold. Do not use dry ice. Seal the third bag securely.

5. Mark the package with appropriate information: "Tissue samples from dead animals; Biological Substance, Category B, UN3373"

6. Contact Martin Grenier, WGFD Nongame Mammal Biologist (307) 332-7723 Ext. 230 to notify that specimens are being shipped.

7. If photographs were taken, mark with the same unique reference # used for marking the specimens. Include CLEAR photos in package or email to martin.grenier@wyo.gov

Voucher specimens and photos should be sent within 24 hours to:

Nongame Mammal Biologist
Wyoming Game and Fish Department
260 Buena Vista Dr.
Lander, Wyoming, 82520

(307) 332-7723 Ext. 230
Martin.grenier@wyo.gov

APPENDIX 1, Continued.

Approved humane euthanasia of bats for White-nose syndrome testing in Wyoming

☐ **Liquid inhalant anesthetics- Halothane, enflurane, isoflurane, sevoflurane, methoxyflurane, and desflurane**
Soak a cotton ball with one of the above listed liquid inhalation anesthetic gases and place inside a sealable heavy-duty ziplock plastic bag, along with the collection container containing bat to be euthanized, and allow sufficient time for the anesthetic gas to cause euthanasia (MIRWG 2008).

☐ **Cervical dislocation**
For small bats under 60 g, cervical dislocation is accomplished by holding the bat with one forefinger across its throat and the thumbnail of the same hand on the back of its neck. With the other hand the hind limbs are quickly pulled backward so that the pressure from the thumbnail causes separation of the cervical vertebrae (Simmons and Voss 2009).

☐ **Thoracic compression**
For small bats under 50 g, thoracic compression is accomplished by quickly and firmly compressing the chest between thumb and forefinger. Compression needs to force all air out of the lungs and should be maintained for at least 2 minutes until the heart stops beating (Simmons and Voss 2009).

APPENDIX 2: MaRS 1 Protocol for decontaminating field equipment when conducting capture surveys for bats in Wyoming

- **Do not** use any field gear that was used to capture bats in a WNS-affected state or region to capture bats in Wyoming (Refer to APPENDIX 5: Useful WNS links)

- Survey equipment

  a) Place a maximum of one bat per cloth holding bag during each survey. After processing, used bags should stay separated from unused bags.

  b) If no bats were suspected of WNS, machine-wash with laundry detergent and dry all holding bags after each survey.

  c) If a bat was suspected of WNS (e.g., dehydrated, emaciated, or a Wing Damage Index of ≥ 2 before June 30), machine-wash all bags as in b), then decontaminate using one of the following methods:

     - Submerse holding bags in Clorox® (6% HOCl) bleach at 1:10 dilution (bleach:water) for at least 10 minutes. Rinse clean with water.
     - Submerse holding bags in water $\geq 122^{o}$F for 20 minutes.

     After rinsing with clean water, dry all bags.

  d) Clean and decontaminate bat processing equipment (e.g., calipers, rulers, etc.) and all bat survey equipment (e.g., processing table, mist-net poles, clip-boards, etc.) and personal field gear (e.g., head lamps, spot lights, etc.) at the end of the survey, regardless if bats are suspected of WNS. Use one of the following:

     - Lysol® IC Quaternary Disinfectant cleaner
     - Professional Lysol® Antibacterial All-purpose cleaner
     - Formula 409® Antibacterial All-purpose cleaner
     - Lysol® Disinfecting Wipes

     Rinse all gear with clean water after disinfecting.

APPENDIX 3: MaRS 2 Protocol for decontaminating field equipment when conducting capture surveys for bats in Wyoming

- **Do not** use field gear that was used to capture bats in a WNS-affected state or region to capture bats in Wyoming (Refer to APPENDIX 5: Useful WNS links)

- Survey equipment

    a) Wear disposable exam gloves while handling bats; use a new pair of gloves each time you handle a new individual.

    b) Place a maximum of one bat per cloth or disposable paper holding bag during each survey. After processing, used bags should stay separated from unused bags or discard disposable paper bags.

    c) Machine-wash all holding bags that were used following each survey. Decontaminate all bags using one of the following methods:

        - Submerse holding bags in Clorox® (6% HOCl) bleach at 1:10 dilution (bleach:water) for at least 10 minutes. Rinse clean with water.
        - Submerse holding bags in water $\geq 122^{o}$F for 20 minutes.

        After rinsing with clean water, dry all bags.

    e) Clean and decontaminate bat processing equipment (e.g., calipers, rulers, etc.) after processing each bat. Rinse processing equipment with clean water after disinfection. Use one of the following:

        - Lysol® IC Quaternary Disinfectant cleaner
        - Professional Lysol® Antibacterial All-purpose cleaner
        - Formula 409® Antibacterial All-purpose cleaner
        - Lysol® Disinfecting Wipes

    d) Clean and decontaminate all bat survey equipment (e.g., processing table, mist-net poles, clip-boards, etc.) and personal field gear (e.g., head lamps, spot lights, etc.) after the end of the survey with one of the products listed above. Rinse all gear with clean water after disinfection.

APPENDIX 4: MaRS 3 Protocol for decontaminating field equipment when conducting capture surveys for bats in Wyoming

- **Do not** use field gear that was used to capture bats in a WNS-affected state or in a WNS-affected region of Wyoming to capture bats in unaffected regions of Wyoming (Refer to APPENDIX 5: Useful WNS links)

- Assure that bat surveys are as low-impact as possible

    a) Avoid surveys in parts of the state where WNS or *G. destructans* is known to occur, if possible
    b) After recording WDI, release pregnant or lactating females without additional processing.

- Survey equipment

    a) Wear disposable exam gloves while handling bats; use a new pair of gloves each time you handle a new individual.

    b) Place a maximum of one bat per cloth or disposable paper holding bag during each survey. After processing, used bags should be separated from unused bags or disposable paper bags should be discarded.

    e) Machine-wash all holding bags that were used following each survey. Decontaminate all bags using one of the following methods:

        - Submerse holding bags in Clorox® (6% HOCl) bleach at 1:10 dilution (bleach:water) for at least 10 minutes. Rinse clean with water.
        - Submerse holding bags in water $\geq 122^{o}$F for 20 minutes.

        After rinsing with clean water, dry all bags.

    f) Clean and decontaminate bat processing equipment (e.g., calipers, rulers, etc.) after processing each bat. Rinse processing equipment with clean water after disinfection. Use one of the following:

        - Lysol® IC Quaternary Disinfectant cleaner
        - Professional Lysol® Antibacterial All-purpose cleaner
        - Formula 409® Antibacterial All-purpose cleaner
        - Lysol® Disinfecting Wipes

f) Clean and decontaminate all bat survey equipment (e.g., processing table, mist-net poles, clip-boards, etc.) and personal field gear (e.g., head lamps, spot lights, etc.) after the end of the survey with one of the products listed above. Rinse all gear with clean water after disinfection.

c) Decontaminate all mist nets after each survey by soaking them in water $\geq 122^{o}$F for 20 minutes.

APPENDIX 5: Useful WNS links

- **National WNS website**

  http://whitenosesyndrome.org/

- **Revised WNS decontamination protocol**

  http://static.whitenosesyndrome.org/sites/default/files/resource/national_wns_revise_final_6.25.12.pdf

- **Case Definitions for WNS**

  http://www.nwhc.usgs.gov/disease_information/white-nose_syndrome/wns_definitions.jsp

- **USGS National Wildlife Health Center: WNS**

  http://www.nwhc.usgs.gov/disease_information/white-nose_syndrome/

- **USGS NWHC bat specimen submission guidelines**

  http://www.nwhc.usgs.gov/disease_information/white-nose_syndrome/USGS_NWHC_Bat_WNS_submission_protocol.pdf

- **Reichard Wing Damage Index**

  http://www.fws.gov/northeast/PDF/Reichard_Scarring%20index%20bat%20wings.pdf

- **Bat Conservation International's WNS page**

  http://www.batcon.org/index.php/what-we-do/white-nose-syndrome.html

- **Cloth holding bags for bats**

  http://www.avinet.com/avi_order.taf?_function=view&ct_id=6