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4 March 2016

Recovery Management Section
Canadian Wildlife Service
Environment and Climate Change Canada
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Re: Proposed National Recovery Strategy for Little Brown Myotis (*Myotis lucifugus*), Northern Myotis (*Myotis septentrionalis*), and Tri-colored Bat (*Perimyotis subflavus*) in Canada

To whom it may concern:

Thank you for the opportunity to comment on the draft Recovery Strategy. We are submitting remarks in our respective capacities as Wildlife Conservation Society (WCS) Canada[1] scientists specializing in wildlife ecology, conservation biology, and landscape ecology.

One of us, Dr. Cori Lausen, specializes in bat conservation and research and leads WCS Canada's Western Bat Conservation Initiative. Through participation in the four major bat working groups in western North America and western Canada, active engagement with the Canadian Interagency WNS Committee, and as a member of the steering committees of the North American Bat Monitoring Program and North American Bat Conservation Alliance, Cori works closely with many bat biologists from across the continent and has a wealth of knowledge about bat conservation and threats.

Dr. Justina Ray, President and Senior Scientist of WCS Canada, is co-chair of the Terrestrial Mammal Subcommittee of COSEWIC and led the 2013 assessment that serves as the foundation of the recent SARA listing. A wildlife biologist whose fieldwork has been focused on wolverine and caribou in northern Ontario, she has worked on issues related to the Species At Risk Act, including as a member of the scientific advisory panel for identification of critical habitat for boreal caribou across Canada.

[1] WCS Canada (www.wcscanada.org) was established in May 2004 as a Canadian non-government organization with a mission to conserve wildlife and wildlands by improving our understanding of and seeking solutions to critical problems that threaten key species and large wild ecosystems throughout Canada. We implement and support comprehensive field studies that gather information on wildlife needs and then seek to resolve key conservation problems by working with First Nation communities, Government and regulatory agencies, conservation groups, and industry.

In this document you will find our comments, which focus most intensively on critical habitat, threats, and strategic direction for recovery. Also appended are some expert opinion data we compiled recently that are relevant for key scientific issues noted in the proposed recovery strategy.

We would like to stress that the comments we provide herein are meant to stimulate Environment Canada to produce a more scientifically-defensible and effective recovery strategy for these three species of bats, which does not fall short of fully recognizing the habitats that are necessary for survival and recovery. We acknowledge that this is a difficult task, working with species that each have different biology, and a threat that has only affected part of the country to date. We hope that we can be of further assistance as the recovery strategy is reworked to better reflect the situation in western Canada, and in particular with regard to identifying and defining critical habitat in a way that best meets the needs of these species. It is highly likely that this recovery strategy will set a precedent for future bat recovery strategies, anticipating that White Nose Syndrome is likely to affect many more species. While there is a sense of urgency to move forward with this recovery strategy, we also recognize that this is a large undertaking that will require time to formulate effectively, and encourage Environment Canada to consider our enclosed comments that may require substantial restructuring of the proposed strategy.

Sincerely,

Cori Lausen, Ph.D.
Research Associate, Bat Specialist

Justina Ray, Ph.D.
President and Senior Scientist

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Overview

The Recovery Strategy (RS) identifies the large threat that White Nose Syndrome (WNS) poses to bats in Canada. It identifies hibernacula as critical habitat for bats, and focuses heavily on WNS as the key source of mortality to populations. While the document explicitly acknowledges that maternity roosts are critical for the survival or recovery of populations, it does not include maternity roosts in its identification of critical habitat. These maternity roosts are, however, essential for the survival and recovery of these bat species (and meet the definition of critical habitat) because they are the habitat features used by females to give birth and raise young.

In failing to include maternity roosts, this document does not use the best currently available information to establish a recovery strategy that will enable survival and recovery of populations affected by WNS and other current or future threats. Additionally, the manner in which critical habitat is identified for hibernacula (specific point locations) poses serious limitations on the effectiveness of the critical habitat identification, because it is limited to point locations that are currently known by the Recovery Team, thereby excluding 1) many additional known locations that do not appear in the Strategy, and 2) the possibility of protecting hibernacula found in the future as critical habitat. This very narrow identification of critical habitat constrains the rapid management that will be needed to respond to a spreading disease such as WNS; additionally, protection of new hibernacula sites which are expected to be discovered in the near future as outlined in the "Actions Already Completed or Currently Underway" section will be delayed with the requirement of unguaranteed amendments to identified critical habitat.

This RS differentiates between WNS affected and unaffected areas, as is appropriate, given the elevated importance of recovery actions in affected areas. However, the necessary balance of recovery and preparing for mitigation actions is not evident in the proposed RS. By identifying critical habitat as only 192 known hibernacula, including some locations in Canada where bats are infected and die from WNS, the RS focuses on the location of the WNS threat, without addressing the recovery actions that will be needed following the inevitable mortality that many bats face from this pathogen. Recovery – in this case the process of increasing population numbers -- post-WNS will be realized through protection of breeding females and their habitats that support optimal reproduction (ie. maternity roosts). Mitigation -- in this case the reduction of WNS mortality -- post-WNS will be realized through inhibition of *Pseudogymnoascus destructans* growth on bats during winter. Preparing for this will require locating hibernacula that house a significant and representative portion of the population. Delaying disease spread and mortality may enable advancements in mitigation techniques and locating more sites for application of future mitigation (e.g., techniques applied at hibernacula, or at maternity roosts). We recommend that the RS be revised to form a more biologically-robust foundation for recovery and mitigation, directing the subsequent Action Plan.

What follows is our detailed review of the proposed recovery strategy, where we outline several deficiencies in the current draft regarding the incorporation of the best available science. We also recommend solutions that are reflective of this science. We start with a necessary modification to the population and distribution objectives. We then address the need for maternity roosts to be included in

the identification of critical habitat and offer an alternative approach for identifying critical habitat (large "bounding boxes") that we consider more appropriate than point locations as a mechanism for habitat protection. We make a case for the need to place a much greater emphasis on promoting habitat stewardship than is apparent in the current draft, and the imperative for including better representation of western Canada in relevant sections identifying threats and level of concern. We close by providing a series of additional recommendations for modifications throughout the draft RS to improve its accuracy.

(Abbreviations used: RS = recovery strategy; CH = critical habitat; EC = Environment Canada; AP = Action Plan)

Major Comments

Section 5. Population and Distribution (PD) Objectives

What is in the proposed RS

Distribution objective:

The distribution objective for both the Little Brown Myotis and Northern Myotis is to "maintain (or where applicable restore to) the pre-WNS extent of occurrence (the area that encompasses the known geographic distribution of the species in Canada as depicted in Figures 1 and 2)."

Population objective (within WNS-affected areas) as currently written in the RS:

Within WNS-affected areas, the short-term (12-18 years) population objective is to maintain (and where feasible increase) the current (2015) level of the population. Within WNS-affected areas, the long-term (many generations) population objective is a self-sustaining, resilient, and redundant population.

Population objective (areas not yet affected by WNS) as currently written in the RS:

Within areas not yet affected by WNS, the population objective is to maintain (and where feasible increase) the current level of the population.

Scientific Issues Noted

We agree that these are appropriate and scientifically sound objectives, with one exception: the *representative* nature of the recovered population. Pre-decline population and distribution, to the extent these are known, are the biologically appropriate long-term PD objectives for a naturally wide-spread and abundant species. Where pre-harm distribution is not fully known for a naturally wide-ranging species, it is critical that PD objectives aim at least for ecologically-representative distributions.

In areas not yet affected by WNS, bats are relatively widespread and thought to be relatively abundant. As there does not seem to be a biological reason that this condition cannot be maintained while WNS-free, we agree with the PD objectives for pre-WNS populations. Because bats, especially females,

demonstrate high roost fidelity, and because the longevity and slow reproductive rates based on body size place bats unique among mammals (Barclay et al. 2003), threats that result in high mortality are likely to lead to severe reductions in populations and distributions, and these will be long term in nature with slow recovery capacity. We thus agree with the short-term population objective outlined in the strategy for WNS-affected areas.

Little Brown Myotis is known, however, to display local adaptations through its range (e.g. morphological differences among populations of varying latitude within Canada; e.g. C. Lausen, unpubl data; Lausen et al. 2008). Recent evidence suggests genetic structure across the range of Little Brown Myotis is tied to ecological settings, especially in the west (e.g., Davy et al 2014; Wilder et al. 2015). Although these data are for Little Brown Myotis, it can be assumed that such variation may also exist for Northern Myotis across its range through varied landscapes of forest structure and matrix composition (e.g. Henderson and Broders 2008). A fully conserved population must be representative of the current (or pre-harm) variation across ecological landscape types (Redford et al. 2011). Because widespread bat species encounter a wide variety of ecological conditions across their distribution, the PD objectives must aim for full representation of current genetic variation within the populations of northern and Little Brown Myotis across Canada. This ensures that the full ecological gradient is represented and captures local adaptations to change. Such representation is needed for maintenance of the evolutionary potential of the species and the full spectrum of interactions bats have within a diverse array of ecological settings (Redford et al. 2011).

Recommended Solution

To be consistent with the best available science, we recommend that the RS be reworded as follows: "Within WNS-affected areas, the long-term (many generations) population objective is a self-sustaining, resilient, redundant, and *representative* population".

Section 7. Critical Habitat

The proposed recovery strategy document acknowledges its insufficient identification of critical habitat. We agree with this insufficiency, and propose some pathways to a more robust framework.

MATERNITY ROOSTS

What is in the Proposed RS

Hibernacula are defined as CH in the proposed RS, but maternity roosts are not, even though both habitat features are critical for the survival and recovery of populations.

Scientific Issues Noted

1. Maternity roosts are not identified as critical habitat. According to the best available science regarding these three bat species, maternity roosts are known to be necessary for these species' survival or recovery (as supported by expert opinion of other bat biologists; see Appendix I). Bats require various roosting conditions at different times of year, and maternity roosts are particularly important for housing females giving birth to young. Individual bats demonstrate fidelity, such that

the same maternity roosts are used year after year. The return of females to particular roost sites over multiple years demonstrates the value of those particular sites to the individuals that use them. These roosts are easily recognized by their key attribute: occupancy by reproductive female bats and/or their young. This is already sufficiently well known to enable the identification of all maternity roosts as critical habitat.

2. The RS carries the assumption that maternity roosts must be identified as point locations. Given the biology of these bat species and their main threat (WNS), this is not the most biologically-supportable approach nor the most effective way to implement the CH identification. Many locations where bats raise young are known and more will continue to be discovered in the near future as community bat programs and citizen science efforts accelerate (as outlined in the Activities Already Underway section of RS). WNS, once introduced into an area, can have dramatic impacts on bat populations in just a few years. Critical habitat identified as point-locations defined on maps in the RS or Action Plan will require frequent and timely updates as new locations are discovered (this holds true for all CH: maternity roosts and hibernacula), a likely unrealistic expectation (see more detailed comments in section below "Defining Critical Habitat").

3. The absence of maternity roosts from the RS in part reflects problems associated with submission of data from private lands. On the 3 Feb 2016 webinar hosted by EC[2], it was disclosed that hundreds of locations of maternity roosts on private lands do not appear in the RS. Participants on the webinar also indicated that many maternity roost locations on federal lands, especially in western Canada, were known by some people on the webinar, but not by EC according to the slides that they presented. There is concern that bats may be intentionally harmed, or habitat made unavailable by private land or building owners in response to the mandatory notification to landowners by EC once CH has been identified on private lands. We understand that there is precedence with this kind of event with other species at risk.

Recommended Solutions

1. **Identify all (100%) maternity roosts as CH.**

Maternity roosts need to be defined as critical habitat consistent with SARA s.41(1)(c) and available evidence for their necessity for bat survival and recovery (see Bat Expert opinions, Appendix I). For the scientifically-defensible population and distribution objectives in WNS-unaffected areas to be met, females must continue to give birth at current rates or higher, thus maintaining or increasing population numbers. This of course also defines the process of recovery in areas post-WNS. Bats reproduce slowly, giving birth often to only a single pup each year, and rates of juvenile mortality are also high at 54-77% (Frick et al. 2010). To recover or maintain population numbers, new individuals need to be added to a population through the process of females giving birth and successfully raising young. As the RS

[2] 3 Feb. 2016 webinar. Hosted by Andrew Boyne and Kathy St. Laurent, Environment Canada. Discussion led by A. Boyne and presentation given by K. St. Laurent. Email invitation sent out by K. St. Laurent to Interagency WNS Committee email list with no restrictions on attendance.

outlines, recruitment from outside Canada, in light of the spreading WNS disease, is unlikely to facilitate recovery. The birthing and rearing process by bats takes place in spring/summer months in maternity roosts. Because females of most bat species show high fidelity to natal roosts (Lewis 1995), having a protected roost to return to following the hibernation period may facilitate the recovery of WNS-infected individuals that survive hibernation. Females emerging from hibernation with already compromised health will especially benefit from not having to search out new roosts while spring fat reserves are low. Suitable or optimal microclimates together with protection from predation provided by maternity roosts will allow for fetal development to commence as early as possible increasing the likelihood of survival of the juvenile through its first year.

In other words, recovery of populations of bats will depend on the protection of maternity roosts. It thus stands to reason that all maternity roosts, being critical to the survival or recovery of a species, and being readily identified by the attribute of presence of reproductive female bats and/or their young, must be designated as critical habitat, as required by the Species at Risk Act.

The partial identification of CH in the proposed Recovery Strategy, currently acknowledged to be 'insufficient to meet the population and distribution objectives" (pg. 54) would be alleviated at least in part by the inclusion of maternity roosts as critical habitat. Environment Canada staff, both in the proposed RS and on the aforementioned webinar, acknowledge the critical role that maternity roosts play in survival and recovery of bat populations, and are aware of the fact that many more maternity roosts exist than appear in the proposed RS.

One way to circumvent the challenge that many maternity roosts are known to exist (e.g., on private lands) and are not on federal lands, would be to define CH as within a large bounding box rather than point locations (see "Defining Critical Habitat" below for details). Private landowner information would not be shared in such a scenario, but maternity roosts would still be identified as CH as they are located through their biophysical attributes (i.e,. occupancy by reproductive females and/or pups).

Maternity roosts may occur in natural features such as rock crevices and tree cavities but may also occur in anthropogenic structures such as bridges and buildings. Anthropogenic structures are commonly used as maternity roosts by Little Brown Myotis, and this is likely due in part to the destruction of natural roosts in areas of human development. All maternity roosts are important and will become increasingly so after WNS impact, when only small numbers of adult females may remain to repopulate. At the time of writing of this RS document, WNS exists only in eastern Canada, but due to its potential to be spread by stow-away bats and humans going underground, this disease could appear at any point anywhere in Canada. All maternity roosts in WNS-affected and in WNS- unaffected areas are therefore necessary for survival or recovery of these bat species to meet the population and distribution objectives of maintaining or possibly increasing bat population numbers in areas currently unaffected by WNS, and given the low reproductive rates of these long-lived mammals. In the case of the Little Brown Myotis, maternity roosts in anthropogenic structures may play a slightly more significant role in survival or recovery, given the energetic and reproductive advantages that are realized by bats in such structures

(Lausen and Barclay 2006). As such, it is necessary that not only maternity roosts be afforded the protection of critical habitat designation, but that these roosts are identified regardless of their anthropogenic or natural source.

2. **Employ a bounding box as an alternative to point locations for identifying CH.** Rather than point locations that are defined on maps, and defined as the only CH until amendments and/or identification of additional sites in the AP, we recommend a bounding box concept, representing the area within which critical habitat is found. Defined by occupancy of each species, we consider such an approach, which has ample precedent, appropriate given the limited information available for the species and the lack of detailed habitat mapping for these areas. Critical habitat would not be comprised of all areas within the identified boundaries, but only those areas where the specified biophysical features/attributes occur. Biophysical attributes of maternity roosts (presence of adult reproductive females and/or young-of-year) will facilitate identification of new maternity roosts; point roost locations, as they become known, will enable management as critical habitat (for further details see "Defining Critical Habitat" below).

Data must be acquired about point locations of maternity roosts, including those on federal lands, but critical habitat identification should not be delayed prior to such data acquisition. A bounding box approach to CH identification for maternity roosts will provide the needed flexibility to accommodate ongoing data collection (see details below). We wish to note that SARA requires identification of CH to the greatest extent possible based on the best currently available information. For further clarification we recommend reviewing the Federal Court judgment in the Greater Sage-Grouse SARA litigation[3]. Environment Canada acknowledged having information for few maternity roost locations[4] on federal lands.

3. **Conduct a systematic, purposeful and thorough solicitation and review of maternity roost locations on federal lands**. We request that EC purposefully solicits maternity roost location information from provincial sources, as it is apparent from discussions with some provincial representatives that this was *not* clearly requested of them, although a clear request was made for hibernacula locations. During the 3 Feb 2016 EC webinar, EC indicated that they were no longer seeking new location data, but that if locations were known, such as those on federal lands (i.e., hibernacula or maternity roosts on federal lands), they could be submitted as part of the comments during the commenting period. In recommending this we are explicitly <u>not</u> recommending a point-location-based identification of

[3] *Alberta Wilderness Association et al. v. Minister of Environment*, 2009 FC 710 (Zinn J.)

[4] On 3 Feb 2016 webinar, Env Canada used a powerpoint slide to show that they knew of 12 sites where maternity roosts were known during the writing of the recovery strategy. Env Canada presented this small number of sites to call participants as justification for excluding maternity roosts from CH definition. Several webinar participants informed EC of knowledge of many more maternity roosts that could be found on federal lands such as national parks, department of defense lands, and national historic sites and monuments. Environment Canada informed participants, when asked about the process by which maternity roost data were obtained, that maternity roost locations were obtained through review of publicly accessible documents and published sources. They acknowledged that they did not specifically solicit federal agencies for locations of maternity roosts, nor did they attempt to obtain reports of summer bat inventories conducted on federal lands.

maternity roost critical habitat, but simply that Environment Canada must gather this information to inform the management of maternity roost critical habitat and to prepare the necessary point locations for known roosts on federal lands that would be needed for posting to the Canada Gazette. See details we provide below on "bounding box" approach to identifying critical habitat for bats ("Defining Critical Habitat").

HIBERNACULA

What is in the Proposed RS

Hibernacula are defined as CH in the proposed RS, with provincial maps showing the known locations. Most provinces, especially in the west, show few sites identified as CH. This is particularly noticeable in B.C. where this province -- rich in mines and karst -- has only one small polygon identifying critical habitat. This CH site delineates some rock crevices possibly used by Northern Myotis to hibernate (based on April, and early Oct acoustic recordings). While there are a number of caves known to possibly house Little Brown Myotis in winter, these sites were not included in the proposed RS because there is some speculation as to whether these could instead be Yuma myotis. This approach is not precautionary, and is just one example of the inconsistency of species confirmation involved with the decision to identify some sites as CH and not others[5].

As outlined in section 4.1, there are a number of actions already underway to identify more hibernacula. For example, BatCaver is a WCS Canada program that is actively seeking bat hibernacula in western Canada. Given the list of actions that are already underway, it is likely that there is to be an important influx of hibernacula locations in the near future. If hibernacula CH is identified using the narrow approach of only including exact point locations, these new sites will be recognized as CH only after: i. an amendment to the RS, ii. inclusion in the Action Plan, or iii. amendment of the Action Plan. This is because each CH site that is currently known is listed as a point location on a map of the corresponding province. If points are not currently known for hibernacula, they are not included as critical habitat. We contend that this is not a biologically appropriate method of CH identification for these bat species, nor is it precautionary or supportive of effective management of hibernacula CH for survival and recovery of these bat species in the face of an imminent threat (WNS) with the potential to jump large geographic distances (e.g, human-mediated transport of *Pseudogymnoascus destructans, Pd*).

Scientific Issues Noted

There are four issues:

1. Hibernaculum critical habitat is being identified only as known point locations. As explained above, this is a narrow and biologically inappropriate approach to identifying critical habitat for bat species.

[5] C. Lausen was informed by K. St. Laurent that a house roost used by Little Brown Myotis on 27 Nov 2014 (capture with genetic identification; C. Lausen, pers. comm; Wildlife Genetics International, Erin Harmston, pers. comm.) and in January 2015 (acoustic recording) was not evidence enough to identify this site as a Little Brown hibernaculum (email correspondences 4 Oct 2015 and 18 Feb. 2016).

2. There is a paucity of point locations of hibernacula identified as critical habitat in the RS.
3. At most of the hibernation sites identified as CH in the RS, especially in the west, there is an extreme sex-bias towards males (Wilson et al. 2014; K. Norquay, pers. comm.; C. Lausen, pers. obs; H. Broders, pers. comm.; additional support by Bat Experts, see Appendix I). The consequence is that male bats are being afforded most of the protection provided by CH in the proposed RS. Females, through birth of new individuals are the more critical sex for the recovery of a population (see section above 'Maternity Roosts').
4. Criteria used for defining a hibernaculum for bats are not clear. Winter use by the three species would seem to be minimum criteria but these criteria are not easily defined. What range of dates constitutes winter? How many bats need to be present to be defined as a hibernaculum? What level of species identification certainty is required? Etc.

Recommended Solutions

1. **Use a Bounding box approach as an alternative to point locations for identifying CH. (see next section "Defining CH").**

2. **Accept location data for sites that are not conclusively used by one of the species at risk.** Such an approach would resolve the current low level of knowledge of hibernaculum locations specific to the three bat species. It would also be consistent with SARA s.38, which requires the Minister to consider the precautionary principle when drafting a RS. For example, if a location is known to have hibernating Myotis bats that are either little brown or Yuma Myotis, the RS should err on the side of caution and include this location. Taking a bounding box approach to CH identification will work in concert with this precautionary approach to point site identification to increase the overall degree of precaution of the CH identification (see next section "Defining CH").

3. **Redefine criteria for defining hibernation period**. We offer the following recommendations:
    - For a hibernaculum to be defined as such for the 3 species at risk, a bat needs to be present at a site at some point during the months of Dec, Jan or Feb, the months when winter is shared by all provinces across Canada, although this time period may extend longer in some areas, and this should be considered on a case by case basis.
    - Genetic evidence should be encouraged (e.g. wing swabs, Player et al. manuscript in prep), but that observation records should also be accepted if they are accompanied by photos of a bat's diagnostic features (i.e. lack of keel, shape of tragus).
    - Acoustic records made during winter months should be accepted as evidence that a hibernaculum is occupied in the winter months even if species confirmation has taken place for a roost in fall or spring, as long as the acoustic signature is representative of the species that was morphologically/genetically confirmed.
    - Because citizen scientists such as cavers are likely to be sources of location information about bats in caves, conclusive species identification may not always be possible; identification of CH should take a precautionary approach.

DEFINING CRITICAL HABITAT

What is in the proposed RS

As mentioned in numerous places already in our commentary critical habitat is: 1) narrowly defined in the proposed recovery strategy as point locations on maps, 2) does not include all known sites at the time of writing the RS, and 3) does not facilitate the necessary rapid inclusion of future identified sites.

The approach in the proposed RS identifying CH for bats is biologically inappropriate given their landscape-scale habitat use and distribution, the rate at which new information is arising, and the unprecedentedly rapid rate at which the key threat, WNS, will impact these species once it affects a region. Instead, a bounding box approach should be used that delineates the geospatial areas that contain the habitat necessary for the survival or recovery of each species. CH inside the bounding box should be defined by occupancy by hibernating bats, by reproductive female bats (or their young), rather than by the narrow approach of point locations.

On the webinar on 3 Feb 2016, it was acknowledged by EC and by a number of participants that many known hibernacula and maternity roosts exist but are not included on the maps in the RS for a variety of reasons, chief among them that they are located on private lands. As outlined in section 4.1 of the proposed recovery strategy, there are a number of actions already underway to identify more point locations of hibernacula. Via the current approach to CH identification, these sites will be recognized as CH only after: i. an amendment to the RS, ii. inclusion in the Action Plan, or iii. amendment of the Action Plan. Each CH site that is currently known is listed as a point location on a map of the corresponding province. If points are not currently known for hibernacula, they are not included as critical habitat. By displaying general areas rather than point locations, a bounding box approach would also avoid the problem of singling out specific private properties.

Scientific Issues Noted

There is no legal requirement for EC to ever amend a RS or AP. This must be considered in the context of this imminent and unpredictable threat (WNS) and the landscape-scale distribution of northern and little brown myotis. The method of defining CH in the proposed RS as point locations -- necessitating amendments to recognize additional CH -- does not lend itself well to protecting these bats. New locations cannot be added as critical habitat after the RS and Action Plan are completed without a formal amendment of these documents. Many more bat hibernacula exist than those currently identified as CH, and an influx of new locations is expected in the near future. While some of these may be known in time for inclusion as CH in an Action Plan, all other locations will require amendments before they can be included in the identification of critical habitat. This same issue applies to both hibernacula and maternity roosts. Many maternity roost locations are expected to be found in the near future.

An amendment process to have sites identified as CH would take a long time relative to the quick pace with which WNS affects populations. WNS has been shown to cause high levels of mortality within two years of first appearing in a hibernaculum (summarized in Forbes 2012). Once a hibernaculum is infected, mortality rates can approach 100%, leaving little time to intervene with mitigation strategies. It

could take several years, if ever, before the recovery strategy or action plan is amended to include newly discovered locations as official critical habitat. Further, it is impractical to think that a RS would be amended each time a new hibernaculum or maternity roost is identified; rather they will be bundled in one or very few amendments, further increasing the delay in identifying them as critical habitat. New locations may be discovered in large numbers in the near future; as indicated in section 6.1 of the proposed recovery strategy, there is a program underway in western Canada that is facilitating an intensive field search for hibernacula (BatCaver.org). New hibernacula have already been located this winter with more expected in the spring. If the RS is finalized by the legal deadline, none of these newly discovered hibernacula will be listed as critical habitat until a future amendment of the RS, and this same problem will exist for years to come.

Recommended Solutions

Spatial delineation. We are proposing that bat CH for both hibernacula and maternity roosts be identified using the bounding box approach, a mixed spatial/aspatial approach commonly used under SARA and Ontario ESA for other widely-distributed species. To apply such a method for maternity roost and hibernacula CH, a bounding box reflecting the federal, or each provincial/territorial, range of each bat species (whatever works best from a management perspective) would be delineated first. Critical habitat (both maternity roosts and hibernacula) within the box would then be defined by occupancy rather than discrete point locations. Bounding boxes may be customized provincially: for example, in Alberta bounding boxes could be drawn around the Rocky mountain and Wood Buffalo karst areas where hibernacula are most likely to occur in the province; a bounding box that includes much of the province might be necessary to include maternity roosts for Little Brown Myotis, whereas this box would be drawn only around the northern half of the province for Northern Myotis maternity roosts.

It is important to underscore both 1) the relatively wide use of this method for CH identification under SARA and the Ontario Endangered Species Act, and 2) that the bounding box identifies the species area of occupancy associated with a description of a defined feature (in this case hibernacula and maternity roosts) location, many of which are not known at this time. In our biological opinion, the occupancy-based bounding box approach is the most scientifically credible, precautionary approach to identifying critical habitat for bats and the one most likely to enable management of CH so as to prevent jeopardy to survival or recovery of these species.

Biophysical attributes. Critical habitat would be defined as existing within the bounding box as having the following biophysical attributes: a structure/feature being used by young-of-the-year and/or an adult female bats who are pregnant or raising young (maternity roost); or, a structure/feature being used by bats to roost during winter (hibernaculum).

All CH is important. As discussed above, consistent with the PD objectives, the best available science indicates that 100% of maternity roosts, and 100% of hibernacula are necessary for survival or recovery of these bat species and are therefore critical habitat. Thus any known location of a hibernaculum or maternity roost within the bounding box would, once known, qualify as critical habitat. A bounding box for each province for each type of CH (hibernaculum vs maternity roosts) for each species would be

most biologically defensible as this would allow biologists familiar with the landscapes and species to define boundaries within which most CH is likely to exist.

Biologically-appropriate response time. A bounding box approach would most easily facilitate the anticipated influx of additional roost locations, and enable the expeditious response that will be needed to properly respond to the unique threat posed by WNS. This disease could show up at any point anywhere in the country, at newly discovered locations. The RS as currently written will not provide protection to new critical habitat in a timely fashion because of its inappropriate use of point locations to identify the critical habitat of these species that are distributed not at a point-scale but at a landscape-scale. Meaningful conservation action with a threat such as WNS that is spreading and causes mass mortality events, can only be realized through a critical habitat designation that allows infinite site location expansion without necessitating document amendments; any delay could jeopardize survival or recovery of these bat species.

Protection beyond Residence. Protection beyond that being provided by identification as a Residence is needed for maternity colonies of bats. It is well known female bats show year to year fidelity to roost sites and to roost areas, but that bats also switch roosts throughout the maternity season to optimize microclimates, respond to threats of predation (reviewed in Lewis 1995), and for social dynamics associated with raising of pups (Willis and Brigham 2004). Bats tend to have areas within which they switch between roosts – using many of the same roosts each year -- during the maternity season (e.g., Little Brown Myotis, Olson and Barclay 2013; Northern Myotis, Olson 2011). Such behaviour is not restricted to natural roosts (C. Lausen, pers. obs.). Providing a level of protection with boundaries that extend beyond an identified maternity roost structure is recommended.

In an earlier draft of the RS that included maternity roosts as CH[6], the following 'areas' were included in the definition of CH:

"In Canada, the maximum roosting area[7] documented for Little Brown Myotis or Northern Myotis is 300 ha (Northern Myotis, Alberta – Olson 2011). As a result, 1 km[8] around each known maternity roost in natural habitats was included in the definition of critical habitat for Little Brown Myotis and Northern Myotis. The maximum roosting area documented for Tri-colored Bat in Canada is 77.4 ha (Nova Scotia – Poissant 2009). Therefore, 500 m around each known maternity roost in natural habitats was included in the definition of critical habitat for Tri-colored Bat."

We concur with the above roosting area delineations and recommend that these be included in the final RS identification of maternity roost critical habitat, knowing that a roost can be compromised by actions that take place close to but outside maternity roost structures. We suggest that the shape of the protected area around each roost be considered in a site by site basis, taking into consideration the

[6] Provided by K. St. Laurent via email to C. Lausen upon request, 26 Jan. 2016.
[7] Roosting area refers to the minimum convex polygon encompassing roost locations used by a colony (Olson 2011). Taken from an earlier draft of the RS (footnote 7).
[8] The maximum roosting area documented for any of the three species is 300 ha. A circle with an area of 300 ha has a radius of 977.2 m. This radius was rounded to 1 km for practicality. Taken from an earlier draft of the RS (footnote 7).

terrain and habitat features likely to be used by bats. Consideration should also be given to roosting areas include anthropogenic roost structures, especially in areas affected by WNS.

Temporal refinement of CH. Biophysical attributes for CH should include a temporal component for proper identification of which areas are critical habitat. Winter across Canada is unequivocally Dec., Jan., and Feb., and may extend for a longer period in some places. A bat that remains in deep torpor for more than one week during a time period of cold weather within Oct – May could be defined as being in hibernation, and thus the feature it is using, a hibernaculum. A reproductive female or young-of-year that is using a feature during the reproductive season, within May – Sept, is using a maternity roost.

Section 4.1 Threats Assessment

What is in the proposed RS

Table 2 lists concern levels of High, Medium and Low for threats to Northern Myotis, Little Brown Myotis and tricolored bat. Currently for areas not affected by WNS, the following are listed in each category:

High or Very High Concern
-WNS
-Destruction or degradation of hibernacula

Medium Concern
-Wind turbine mortality
-Destruction or degradation of roosts
-Recreational or scientific disturbance of individuals

Medium-Low Concern
-Intentional harm to individuals
-Destruction/degradation/conversion of foraging habitats

Low Concern
-Industrial disturbance of individuals (e.g. mining, forestry)

Scientific Issues Noted

Not all threats are properly represented here, and concern levels do not necessarily reflect western areas.

Recommended Solutions

It is not clear how this threats table was compiled, but we strongly **recommend that the IUCN threats assessment (threats calculator) be used**; this would provide a strategic method for identifying and quantifying threats. It is our understanding from experience with other recovery strategies in Canada within the past couple years, that this is now standard practice for SARA recovery strategies and management plans. This could be completed for this recovery strategy through a survey of the larger community of bat biologists – precedent exists for this approach (e.g., Western Bat Working Group).

What follows are suggested changes to what currently exist in the proposed RS.

- Because the word 'degradation' implies roosts 'are broken down or deteriorated' we request that an additional adjective be used in the first 2 threats under the "habitat loss and degradation" section:

- "Destruction, degradation or harmful alteration of hibernacula" – this includes things such as unsuitable (bat unfriendly) gates or other types of closures being applied to mines/caves, which is has been done by industry, private landowners and cavers in the west. This could impede bats, change airflow, etc. so as to decrease the capacity of the hibernacula to support the life processes bats use them for.

- "Destruction, degradation, or harmful alteration of roosts" – this includes things such as building renovations that inadvertently seal bats out or in, or change microclimates of roosts to be unsuitable. Based on our experience with bat threats in the west, wind turbine mortality of little brown and Northern Myotis is less of a threat than destruction/degradation/harmful-alteration of roosts to these species. There have been some wind turbine mortalities of these species, but this is thought to be far fewer than those that are inadvertently killed each year due to roost destruction or alterations. Additionally, roost destructions can kill large numbers of reproductive females, and could eliminate a complete genetic matrilineal lineage. Turbine mortalities are unlikely to cause such a skew in loss of genetic variability. We thus request the threat of destruction/degradation/harmful-alteration of roosts in non-WNS areas be elevated to High given that this ranking would be most consistent with the population and distribution objectives or maintaining or increasing population numbers, including the addition of the adjective "representative" as outlined above.

Section 6.2. Strategic direction for Recovery

What is in the draft RS

As currently written, there is no mention of promoting bat habitat stewardship in the Strategic Direction for Recovery section (Section 6.2) of the RS. In fact, the draft RS uses the word *stewardship* only once (page vii), in reference to potential ways of slowing human-assisted spread of Pd spores. There is mention only of 'delivering outreach products to key interest groups ….on the importance of maintaining hibernacula and maternity roosts and the consequences of WNS (pg. 50, last table entry)'.

'Intentional harm to individuals' is listed in Section 4.1 as a threat of high concern and high severity in WNS-affected areas.

Scientific Issues Noted

'Intentional harm to individuals' is listed in Section 4.1 as a threat of high concern and high severity in WNS-affected areas. Because the ranges of all three bats include substantial areas of private lands

where maternity roosts certainly occur, private lands are highly likely to contain critical habitat for these species. Accordingly, it is vital that recovery strategies include stewardship programs designed to educate building owners (e.g., citizens who own private dwellings on public lands such as within national parks or on Indian Reserves) and private landowners for the purpose of providing support and guidance. Such outreach will be necessary to help ensure that evictions of bats are done in a bat-friendly manner, bats are appropriately considered in renovations, bats are not harmed, and that all health and safety concerns are dealt with appropriately such as sealing bats out of living quarters. Especially post-WNS infection, intentional harm to bats by land- or building-owners could have tremendous negative impacts on population recovery with potentially small numbers of surviving individuals representing the only source for population recovery. Proactive stewardship measures in areas currently unaffected by WNS stand to provide long-term benefits, and are needed to meet the appropriate population objectives of maintaining or increasing population numbers of bats in these areas.

Recommended Solutions

We request that **habitat stewardship actions** have a more significant presence in the proposed RS. The action outlined in the last entry in Table 2 on page 50 of the proposed RS thus needs to be amended. Instead of just stating 'delivery of outreach products' and 'communicate the importance of bats…', additionally state: '**Provide support for landowners with bats on their properties and use these opportunities to engage citizens in helping fill knowledge gaps to recovery, and conduct specific actions to help recover/maintain populations.**'

The following statements should also be included and information considered: 1. "encourage two-way information sharing"; 2. "educate people not just on the importance of maintaining hibernacula and maternity roosts, but on the methods for doing so. To reduce the chance that landowners *unintentionally* harm bats (e.g. renovating at an inappropriate time of year that could trap pups), provide landowners and building owners with information about steps required to be good stewards of bat habitat;" and 3. explore and implement SARA stewardship tools including s.11 conservation agreements and landowner compensation to maximize the success of stewardship actions.

Educating private landowners and providing guidance for stewardship of these species and their habitats is likely to be one of the most effective recovery strategies that can be taken for bats, especially for the little brown myotis that typically roost in anthropogenic structures. To ensure that intentional harm to bats by humans does not become a threat of increasing concern (e.g., outcomes of landowner uncertainties about ramifications of species' listings and critical habitat designations), we **recommend that the RS clearly outline the need for programs that promote stewardship**, thereby strengthening and expanding upon the 3rd entry in Table 3. More specifically, the RS should acknowledge the importance of developing, promoting, and where possible financially supporting, bat habitat stewardship programs aimed at Canadian citizens.

Additional Comments

RS Text: Recovery Feasibility Summary Page vii. Point 4. Recovery techniques exist to achieve the population and distribution objectives. Lines 12-14. "…habitat management and stewardship to prevent (or slow) the human-assisted spread of the spores that cause WNS may be effective recovery techniques for these species."

> Our comments: The prevention or slowing of human-assisted spread of spores delays the spread of WNS, and is not a recovery strategy per se. At best, this action is 'loss prevention' only. There is no evidence to date to support the notion that this fungus will not continue to be spread by bats. We suggest that this reworded to:
>
> "…habitat management and stewardship to prevent (or slow) the human-assisted spread of the spores that cause WNS may be effective at delaying loss of individuals while potential treatments and mitigation measures are researched and tested".
>
> This will then eliminate the need for the statement on line 15 ("Potential treatments….tested").

RS Text: Recovery Feasibility Summary Page vii. Point 4. Recovery techniques exist to achieve the population and distribution objectives. Lines 16-17. "Habitat enhancement techniques that increase the availability of optimal roosting locations in areas where bats are known to raise young may aid in the recovery of these species."

> Our comments: As we have detailed in our Major Comments section above, maternity roosts are where young are raised, and thus protection of these habitat features are most directly able to recover populations. **Protecting habitats that bats have already selected as maternity roosts is a better approach than using enhancement techniques.** Because the influence of habitat enhancement techniques, such as bat-houses, on reproductive success of individuals has not been studied, relying on these structures instead of protecting roosts already in use is not an appropriate recovery strategy. We suggest that this be reworded:
>
> "Habitat protection for maternity roosts where bats are known to raise young is likely to aid in the recovery of these species. Appropriately designed and tested habitat enhancement techniques that increase the availability of optimal roosting locations for bats to raise young may additionally aid in the recovery of these species."

RS Text: Species Information. Pg. 5. Little Brown Myotis.

> Our comments: We recommend adding a sentence to this section:
>
> "When acoustically recorded in treed or otherwise cluttered environments, little brown and Northern Myotis produce echolocation calls that are very similar and can be confused with other Myotis species."

RS Text: Species Information. Pg. 5. Northern myotis

Our comments: We recommend adding a sentence to this section:

"When acoustically recorded in treed or otherwise cluttered environments, little brown and Northern Myotis produce echolocation calls that are very similar and can be confused with other Myotis species."

RS Text: Species Information. Pg. 9, range map for *M. septentrionalis*.

Our comments: The western extent of this range map falls short. We have genetic evidence of this species at Hazelton, BC (UTM: 9 U 588135 6123545; Lausen et al. 2016).

RS Text: Overwintering and swarming habitat, Pg. 17, top of page.

"Swarming behaviour often occurs in and around entrances or openings of hibernacula."

Our comments: Because swarming behaviour is not as closely tied with hibernation sites in B.C., we suggest qualifying this sentence with the following extension:

"…or openings of hibernacula. However, on Northern Vancouver Island congregations of swarming bats have been documented in late August at caves (Davis et al. 1999) and by October, few individuals remain (C. Lausen, pers. obs.) with only a few bats observed hibernating inside the caves mid-winter (M. Davis, pers. comm.)."

RS Text: Little Brown Myotis, Pg. 17, line 29.

"In western Canada, the number of Little Brown Myotis hibernating together may be substantially less than in northeastern North America; bats likely hibernate singly or in small groups west of the Rocky Mountains (Jung et al. 2014)."

Our comments: As clusters as large as 52 Little Brown Myotis have been observed in SW Northwest Territories, we suggest this data be included:

"In western Canada, the number of Little Brown Myotis hibernating together may be substantially less than in northeastern North America, although clusters as large as 52 individuals have been observed in a hibernaculum of 3000 Little Brown Myotis in southwestern Northwest Territories (Lausen 2011); bats likely hibernate singly or in small groups west of the Rocky Mountains (Jung et al. 2014)."

RS Text: Tri-colored Bat, Pg. 22, 3rd line from bottom.

"…body weight (Naughton 2012)."

Our comments: As Naughton 2012 is not a source of any original research, we recommend that you change all occurrences of this citation to "reviewed in Naughton 2012", or cite the original research instead wherever possible.

RS Text: Infection of the remaining Canadian range of Little Brown Myotis and Northern Myotis. Pg 29, Line 28.

"….pers. comm.) and in the awnings of camper vans (C. Lausen, pers. comm.)."

Our comments: As the observation of bats transported in camper van awnings was actually made by Alberta biologists in relation to a known transport of bats, we suggest you change this to "…camper vans (D. Hobson, G. Horne; pers. comm.)".

RS Text: Population and Distribution Objectives, Little Brown Myotis and Northern Myotis. Pg. 42, 4th line from bottom.

"In Canada, as WNS approaches less forested regions of southeastern Manitoba, the relative dryness and lower density of trees suggest that transmission may occur at a slower rate. Nevertheless, it is acknowledged that it may not be possible to prevent the spread of WNS."

Our comments: While lower density of trees may impact Northern Myotis movement and hence the westward spread of WNS by that species, Little Brown myotis, through their use of rock crevices and buildings, are likely to carry this fungus west of Manitoba. In fact, Little Brown Myotis disperse along river valleys in the prairies, and may travel long distances to mate; this behaviour could in fact promote a westward spread of this disease once the spores reach a major prairie river system. Where Northern or Little Brown Myotis hibernate in Saskatchewan, of if they move out of the province in winter, is not known and therefore it cannot be assumed that their hibernacula would have drier conditions. We suggest that this section be reworded to account for these uncertainties.

"In Canada, as WNS approaches less forested regions of southeastern Manitoba, the lower density of trees suggests that westward transmission of WNS by Northern Myotis may occur at a slower rate. In Little Brown Myotis, however, evidence of geneflow across the prairies (Davy et al. 2014), together with this species' tendency to disperse along river valleys (Lausen 2007) and use of buildings as roosts, suggests that WNS may continue to spread westward across the prairies. As non-cavernicolous hibernation sites for this species are unknown in the prairies, growth rate of *Pd* on hibernating Little Brown Myotis residing in the prairie region during summer cannot be predicted. It is therefore acknowledged that it may not be possible to prevent the spread of WNS."

RS Text: Section 6. National. Western Canada and northern Canada. Pg. 45-46 bullets 5 and 8.

Bullet 5 "Winter bat activity is being monitored throughout southern British Columbia by Cori Lausen (Wildlife Conservation Society Canada), Environment Canada- Canadian Wildlife Service, the British Columbia Ministry of Environment (Dr. Purnima Govindarajulu) and others."

Our comments: Because winter activity is being monitored across the province, please also add this information.

- "Winter bat activity is being monitored throughout southern British Columbia by Dr. Cori Lausen (Wildlife Conservation Society Canada), Environment Canada- Canadian Wildlife Service, the British Columbia Ministry of Environment (Dr. Purnima Govindarajulu) and others; winter activity is being monitored across northern and central B.C. by Dr. Cori Lausen."

Bullet 8 "Dr. Cori Lausen is leading a liaison project (Bats and Cavers Project) with the caving community in British Columbia and Alberta to map bat use in caves and other underground habitats."

Our comments: Please add the website information about BatCaver.org, and make a slight adjustment to the description of this activity. Please see the Literature Cited section below for citations used.

- "Dr. Cori Lausen is leading a liaison project (Bats and Cavers Project; BatCaver 2015) with the caving communities in British Columbia and Alberta to locate caves and mines used by bats."

We also suggest that **two additional bullets** be added to this section:

- "Thompson Rivers University, Dr. Ann Cheeptham, funded by US Fish and Wildlife Service is investigating new sources of *Pd* inhibition from cave microbes."
- "Alberta Community Bat program is a new initiative in Alberta to provide resources to private landowners, and engage citizens in bat conservation efforts including locating and reporting roosts (Community Bat Program of Alberta 2016)."

RS Text: Section 6.2. Strategic Direction for Recovery. Table 3. General description under 2nd threat, Knowledge gaps to recovery and all threats, under "Entire Range", 2nd bullet.

Bullet 2 "Continue to investigate habitat use across the Canadian ranges of the species."

Our comments: Suggested revision:

"Continue to investigate habitat use in all seasons of the year across the Canadian ranges of the species."

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Appendix I – Survey of Bat Experts -- Results

From 22 Feb. – 2 March 2016, we sent an on-line survey to **bat experts** that contained 6 questions. Because this survey was distributed via listserves, it is unknown how many biologists received the survey invitation. We received responses from 51 bat biologists (Table 1). The questions underpinned some of the scientific issues noted in our comments. There were many written comments to these questions that elaborated on the multiple choice answers provided. For brevity, we have not included these comments, but will be provided to Environment Canada upon request. Names of 49 respondents (2 respondents were anonymous) with cumulative bat expertise of more than 635 years are listed in Table 2.

Table 1. Survey responses from 51 bat expert respondents.

Question Asked in Survey	Total Responses	Yes (%)	No (%)	Maybe (%)	Don't Know (%)
Based on your knowledge, are maternity roosts critical for the survival or recovery of bat populations?	49	100%	0	n/a	n/a
In an earlier draft of the Canadian national recovery strategy for Little Brown Myotis, Northern Myotis, and Tricolored Bat, Environment Canada proposed only recognizing large maternity colonies as critical if more than 10 maternity roosts are known in the province. The population objective outlined in the recovery strategy for northern and Little Brown Myotis in areas unaffected by White Nose Syndrome is to: maintain, and where feasible increase, the population compared to its 2015 level. **Based on your knowledge, would protection of only large maternity colonies in areas unaffected by WNS be sufficient to meet this population objective?**	49	2%	78%	20%	n/a
Based on your knowledge, are all maternity roosts likely to be essential for the recovery of bat populations (Little Brown Myotis, Northern Myotis) after they have been impacted by WNS?	46	80%	20%	n/a	n/a
Based on your knowledge, do anthropogenic structures play an important role in population survival or recovery of Little Brown Myotis in Canada?	35	97%	3%	n/a	34%
Based on your knowledge, would recovery of Little Brown Myotis populations be impeded following WNS outbreak if anthropogenic maternity roosts (e.g. buildings) were not available?	39	97%	3%	n/a	23%
If you have knowledge of hibernation sites for Little Brown Myotis, is it your understanding that there is a male bias of individuals at these sites?	51	8%	4%	4% (in some cases)	84%

Table 2. Respondents who shared their name and contact information (49/51) were as follows:

Name	Affiliation	Number of Year of Experience With Bats	Highest Degree of Education
Bryce Maxell	Montana Natural Heritage Program	11	Ph.D.
David Yates	Biodiversity Res. Inst.	11	Masters
Bronson Curry	SUNY ESF	4	B.A.
Robert Barclay	University of Calgary	40	PhD
Katie Gillies	Bat Conservation International	15	Master's of Science
Dan Neubaum	Colorado Parks and Wildlife	17	M.S. Wildlife Biology
Brian Slough	Independent Consultant and Researcher	20	M.Sc.
Paul Cryan	U.S. Geological Survey	26	PhD
Brock Fenton	University of Western Ontario	>50 years	Ph.D.
Theresa Mathis	USFS	6	Master of Science
Juliet Craig	Kootenay Community Bat Project	12	Master of Science
Margaret Holm	BC Community Bat Program	2	Masters
Gary Fellers	USGS	30	PhD
Ingebjorg Jean Hansen	Independent Consultant	7	Bachelor of Science, Master of Science Candidate
Mike Sarell	Ophiuchus Consulting	30	BSc
D. Lewis Young	retired federal wildlife biologist	10	Master of Science
L. Andrusiak	SNC-Lavalin	5	M. Sc., R. P. Bio.
Zachary Kaiser	NaturEner USA	5	Masters of Science in Biology
Tanya Dewey	Colorado State University	17	PhD
Lenny Shirose	CWHC	8	MSc
Jordi Segers	Canadian Wildlife Health Cooperative	4	MSc
Dr. Christina Davy	Trent University / Liber Ero Fellowship Program	11	PhD
Pierre Johnstone	BCBAT	20	Masters
John Chenger	Bat Conservation and Management, Inc.	25	
Lesley Hale	OMNRF	8	BSc
Laura Kaupas	University of Calgary	4	BSc, completing MSc

Anouk Simard	Ministère des Forêt de la Faune et des Parcs du Québec	5	PhD
Joanna Burgar	Government of Alberta - Environment & Parks	6 (4 in Australia)	PhD
Walter Bertacchi	Ministère Forêt Faune et Parcs	9	DEC CEGEP
Nathalie Desrosiers	MFFP	6	Master
Michael Darren Baker	California Dept. of Forestry & Fire Protection	24	Doctorate
Barbara Smith	USFS	15	BS
Doug Burles	Regional coordinator, BC Community Bat Program	18	Master of Science
Scott McBurney	Canadian Wildlife Health Cooperative	5	Doctor of Veterinary Medicine
Terri Pope	Utah Division of Wildlife Resources	2	PhD
Barb Johnston	Parks Canada	5	MSc
Cory Olson	Independent bat biologist	7	M.Sc.
Rita Dixon	Idaho Department of Fish and Game	16	PhD
Justin Frye	Bureau of Land Management	4	Bachelors of Science
L.Wilkinson	AB Government	20	Masters
Jared Hobbs	Hemmera	5	Masters
Mandy Kellner	Independent Consultant	20	MSc
Lori Salzer	Washington Dept of Fish & Wildlife	6	BS
Susan Holroyd	Independent Wildlife Biologist	25+	M.Sc. (behavioural ecology of bats)
Dr Michelle Evelyn	UBC Biodiversity Research Centre	20	PhD
Pamela Zevit	South Coast Conservation Program	3	College
Lisa Sims	P. Biol.	5	B.Sc.
Brian Paterson	Hemmera, RPBio	7	BSc, B.Eng
Todd Stefanic	NPS - Craters of the Moon NM & P	4	BS Wildllife Management