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Revision 0

Idaho National Laboratory Site Bat Protection Plan Annual Report 2023

December 2023

Idaho National Laboratory

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Idaho National Laboratory Site Bat Protection Plan Annual Report 2023

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ABSTRACT

Bats are important ecosystem components on the INL Site and represent over 30% of mammals described on the Site. Over the past decade, white-nose syndrome and wind-energy development have caused widespread bat mortality in North America. Because of these threats and their potential to affect development and operations on the INL Site, in 2018 DOE-ID produced a Bat Protection Plan for the INL Site in conjunction with the Idaho Department of Fish and Game (IDFG) and U.S. Fish and Wildlife Service (USFWS).

The 2023 annual report provides updated information on bats counted during hibernacula surveys, passive acoustic monitoring, participation in the North American Bat Monitoring Program, white-nose syndrome surveillance, bat carcass recovery and assessment at INL Site facilities, relocating live bats at facilities, and public outreach for bats on the INL Site from March 2022 until March 2023. This annual report will ensure that the USFWS, IDFG, and other collaborators have current information concerning bats on the INL Site, especially for those species of conservation concern. Such information will help contractors at the INL Site with project planning and construction and will allow DOE-ID to continue its mission with minimal delays from an Endangered Species Act (ESA) listed bat.

ACKNOWLEDGEMENTS

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CONTENTS

FIGURES

TABLES

ACRONYMS

ATR	Advanced Test Reactor
BEA	Battelle Energy Alliance, LLC
CFA	Central Facilities Area
CITRC	Critical Infrastructure Test Range Complex
DOE-ID	U.S. Department of Energy, Idaho Operations Office
ECP	Environmental Compliance Permit
ESA	Endangered Species Act
IDFG	Idaho Department of Fish and Game
INL Site	Idaho National Laboratory Site
INTEC	Idaho Nuclear Technology and Engineering Center
MFC	Materials and Fuels Complex
NABat	North American Bat Monitoring Initiative
NEPA	National Environmental Policy Act
NRF	Naval Reactor Facility
NRG	Natural Resource Group
RWMC	Radioactive Waste Management Complex
TAN	Test Area North
USFWS	U.S. Fish and Wildlife Service
WNS	White-nose Syndrome

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1.0 Introduction

The Idaho National Laboratory (INL) Site is a U.S. Department of Energy, Idaho Operations Office (DOE-ID), reservation encompassing 890 mi^2 (230,509 ha) on the eastern Snake River Plain approximately 25 mi (40 km) west of Idaho Falls. The INL Site is federal property administered and overseen by the DOE-ID.

Bats are important ecosystem components on the INL Site (DOE 2018, Whiting et al. 2015, Whiting et al. 2018a) and represent over 30% of mammals described on the Site (Reynolds et al. 1986). A mosaic of high-quality, shrub-steppe habitat overlying near-surface basalt deposits with abundant lava-tube caves, fractured rock outcrops, talus-flanked buttes, and juniper (*Juniperus* spp.) uplands provide foraging and roosting habitat for resident and migrant bat species, including at least six with heightened conservation concern (DOE 2018, IDFG 2022b, Whiting et al. 2015). Since the early 1980s, the DOE-ID has supported bat monitoring on the INL Site (Genter 1986, Haymond and Rogers 1999, Whiting et al. 2022). Results of that monitoring have advanced bat conservation at the INL Site and provided important data to state and federal resource agencies in Idaho and the western United States of America for the conservation of bats and their habitat (Whiting et al. 2021, Whiting et al. 2018a, Whiting et al. 2018b).

Over the past decade, the emergence of white-nose syndrome (WNS) and large-scale, commercial wind-energy development have caused widespread mortality in bats in North America (Hoyt et al. 2021, Hein and Schirmacher 2016, Hammerson et al. 2017). These threats have resulted in precipitous declines of numerous common bat species, and elevated conservation concern for bats across North America (O'Shea et al. 2018, Knudsen et al. 2013, Weller et al. 2018). In October 2021, the fungus that causes WNS (*Pseudogymnoascus destructans)* was documented on bats in Minnetonka Cave in southern Idaho, which is about 118 miles (190 km) southeast of the INL Site (IDFG 2022a). Also, a 450-megawatt wind-energy facility has been approved for construction off the INL Site and within 0.6 mile (1 km) of the southeast border of the INL Site in Bingham and Bonneville counties. Moreover, the little brown myotis (*Myotis lucifugus*) is currently being considered for listing under the Endangered Species Act (ESA). In 2018, the DOE-ID produced a Bat Protection Plan for the INL Site (DOE 2018) and has since produced an annual report providing current information on the conservation of bats and their habitat on the INL Site considering these impending conservation concerns. The purpose of the Bat Protection Plan is to complete the following objectives (DOE 2018):

1. Document the natural history and bat ecology on the INL Site to better conserve and manage these mammals and their habitat.
2. Provide information on trends of abundance, distribution, and seasonal habitat use by bats, which will allow the DOE-ID to make informed decisions for project planning required by the National Environmental Policy Act (NEPA).
3. Maintain current information on sensitive bat species on the INL Site to facilitate the biological assessment and biological opinion process required by the ESA, if a species becomes listed under the ESA. Such information will allow the DOE-ID to continue its mission with minimal delays from an ESA listing.
4. Verify that the DOE-ID supports section 2 of the ESA if a bat becomes listed and identify potential credits to the DOE-ID for voluntary prelisting conservation actions as described by the U.S. Fish and Wildlife Service (USFWS) if that policy is enacted.
5. Share data collected from the monitoring program with biologists from the USFWS, Idaho Department of Fish and Game (IDFG), the U.S. Bureau of Land Management, and Craters of the Moon National Monument and Preserve to support conservation and management of bats and their habitat in areas adjacent to the INL Site.

6. Tier bat conservation actions at the INL Site to the Idaho State Wildlife Action Plan.

2.0 Bat Protection Plan Annual Report

This annual report provides the USFWS, IDFG, and other collaborators with current information concerning bats on the INL Site, especially for those species of conservation concern. Such information will help contractors at the INL Site with project planning and construction. This report will also provide the following required information as described in the "Idaho National Laboratory Site Bat Protection Plan" (DOE 2018):

- Describe objectives, methods, results, and interpret findings from monitoring data,
- Assess the efficacy of conservation measures,
- Make recommendations for additional study, evaluate management actions, and propose plan revisions.

This annual report appends the 2022 annual report and contains data from the monitoring program from March 2022 to March 2023. In conjunction with this update, the DOE-ID, USFWS, IDFG, BEA NRG, and the Naval Reactors Facility (NRF) will meet to discuss changes in any section of the plan (e.g., fluctuations in trends of bat abundance on the INL Site or WNS monitoring), changes in the conservation status of bats that occur on the INL Site, or new policies that will benefit the conservation and management of sensitive bat species or their habitat (DOE 2018).

3.0 Describe Objectives, Methods, Results, and Interpret Findings from Monitoring Data

3.1 Hibernacula Counts

Estimating long-term population changes of bats is critical for targeting management and providing important information for habitat management (Whiting et al. 2018b, Ingersoll et al. 2016). Population estimates are determined by counting bats in caves during hibernation (Ellison et al. 2003, Prendergast et al. 2010). These counts are one of the best ways to estimate population change, because bats use the same hibernation sites for decades (Gillies et al. 2014, Whiting et al. 2018a, Whiting et al. 2021). Counts of hibernating bats on the INL Site were conducted between November 1 and March 31 using established protocols and care to minimize disturbing bats (Whiting et al. 2018a, Whiting et al. 2018b). On January 3, 2023, counts were conducted in North Tower Earl, North Tower Wackenhut, and Rattlesnake caves. High amount of snow and equipment failure precluded conducting counts in other caves. The number of bats counted in 2023 was compared with historical numbers of bats counted in those caves. During those surveys, researchers counted 116 Townsend's big-eared bats (*Corynorhinus townsendii*) and 26 western small-footed myotis (*M. ciliolabrum*, Figure 1).

Hibernacula counts of Townsend's big-eared bats and western small-footed myotis often exhibit large amounts of variation across years (Sherwin et al. 2003, Whiting et al. 2018b). That variation is normal as bats likely use different caves for hibernation (Bosworth 1994, Wackenhut 1990, Whiting et al. 2018b) and because of variation in use of areas inside hibernation sites, which influences observers seeing and counting those species (Safford 1990). Counts of those species in 2023 fell within the normal variation of historical population counts on the INL Site for North Tower Earl, North Tower Wackenhut, and Rattlesnake caves, which indicated that there was not a decline in number of Townsend's big-eared bats and western small-footed myotis on the INL Site in those three caves. Hibernacula surveys are scheduled to be conducted again during winter 2023/2024 in all caves.

Understanding long-term changes in bat populations is needed for conservation of these mammals (Weller et al. 2018, Whiting et al. 2018b). The INL Site data from hibernacula surveys underscore the importance of the INL Site, regionally, for hibernating Townsend's big-eared bats and western small-footed myotis (Whiting et al. 2018a, Whiting et al. 2018b). These results quantify long-term trajectories of these populations and will guide biologists in prioritizing caves to sample for the arrival of WNS and help with the management and conservation of bats and their habitat, as well as aid in land-use planning on the INL Site (Whiting et al. 2018a, Whiting et al. 2018b).

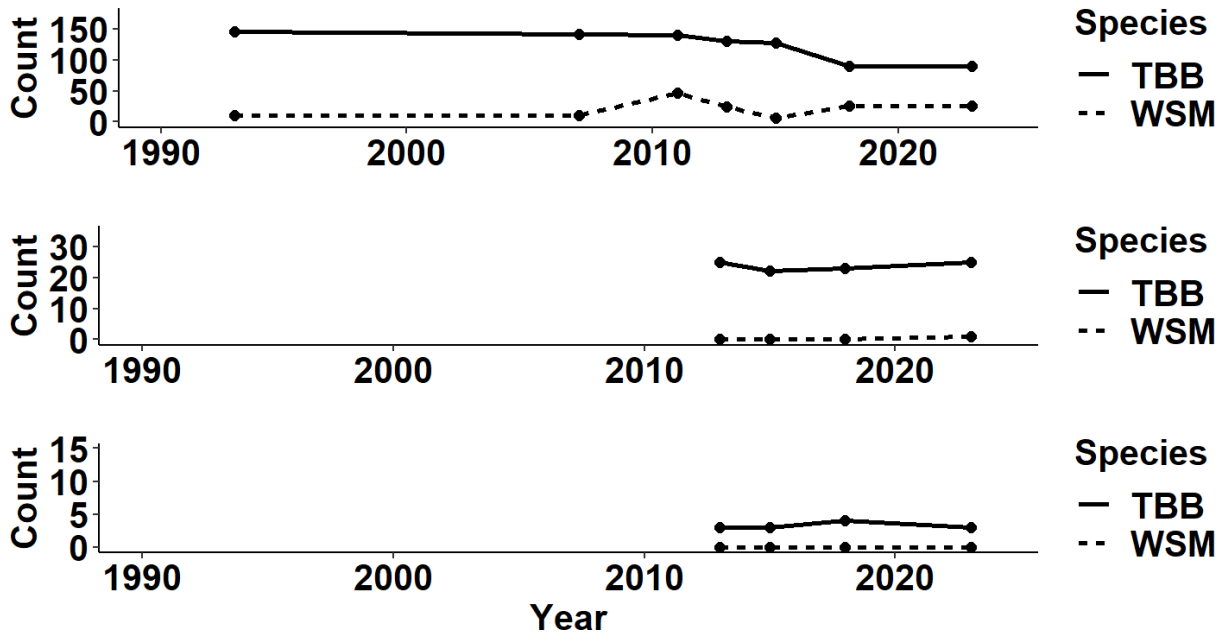


Figure 1. Number of Townsend's Big-eared Bat (TBB) and Western Small-footed Myotis (WSM) counted in Rattlesnake (top), North Tower Wackenhut (middle), and North Tower Earl (bottom) caves on the Idaho National Laboratory Site in each year when consistent survey methods were used.

3.2 Passive Acoustic Monitoring

Acoustic detectors are effective at identifying bat species and quantifying bat activity because bat calls are consistent in structure and have species-specific characteristics (Miller 2001, O'Farrell and Gannon 1999, Whiting et al. 2022). These devices have been used extensively to study bat winter ecology (Whiting et al. 2019, Bernard and McCracken 2017, Lausen and Barclay 2006). Little is known about bat hibernation behavior in the western USA prior to the arrival of WNS (Knudsen et al. 2013, Schwab and Mabee 2014, Weller et al. 2018). Anabat SD2 units have reflector plates oriented at 45° angle from the center axis of the microphone to minimize echo and clutter noise (Britzke et al. 2010, Reynolds et al. 2017, Skalak et al. 2012). Each detector was programmed to record at least from sunset to sunrise (Miller 2001, Johnson et al. 2017, Nocera et al. 2019, Whiting et al. 2019), and the division ratio was set at eight. The sensitivity of Anabat detectors was adjusted to exclude the ambient noise (Britzke et al. 2013, Whiting et al. 2019). When triggered by a bat call, detectors create one, ≤ 15 sec file, labeled with a unique date and time stamp.

3.2.1 Winter Passive Acoustic Monitoring

Anabat Swift detectors were set at nine hibernacula on the INL Site during winter (1 November to 31 March) from 2022 to 2023. Detectors were powered by external batteries and solar panels. Each unit was equipped with a BatHat to reduce damage to equipment from rain, snow, and freezing temperatures

(Britzke et al. 2010). Microphones were placed about 3 m above the ground and positioned so the center axis of the zone of reception was approximately 15° above the horizon (Johnson et al. 2017, Klüg-Baerwald et al. 2016). Microphones were oriented to maximize detection near cave entrances while trying to avoid recording near-ground noise and echoes (Britzke et al. 2010, Schwab and Mabee 2014). When triggered by bats flying outside of hibernacula, detectors create one ≤ 15 second call file, labeled with a date and time stamp. During winter of 2022/2023, Anabat detectors at all caves had microphone issues and malfunctioned, except for at North Tower Earl Cave. Therefore, the winter acoustic data could not be analyzed for the winter of 2022/2023.

Instead of analyzing acoustic data for winter of 2022/2023, the process of comparing analyses of winter acoustic data using Kaleidoscope Pro Analysis Software 5.6.0 (Kaleidoscope) versus AnaLookW Analysis Software began. From 2011 to 2018, filters and manually vetted calls in AnaLookW were used to identify bat calls (Whiting et al. 2021). As Kaleidoscope software became more powerful and easier to use (López-Baucells et al. 2021, Clement et al. 2022, Laverty and Berger 2022), the INL biologists wanted to transition to that software. To compare the two software programs, unclassified call files from 8 caves during November 1 to March 31 from 2011 to 2018 were used. These call files were classified by species using Kaleidoscope and compared to call files that were previously filtered and manually vetted using AnaLookW. The results between the two software programs were then compared.

In Kaleidoscope, data was first filtered searching for western small-footed myotis and Townsend's big-eared bats call files. Only call files of western small-footed myotis and Townsend's big-eared bats were analyzed, because those species represent >99% of bats observed during hibernacula counts (Whiting et al. 2018a, Whiting et al. 2021). Kaleidoscope was used for automatic species identification (López-Baucells et al. 2021, Clement et al. 2022, Laverty and Berger 2022). The information under signal parameter tab was left at the preset. In the *Auto ID for Bats* tab, *Bats of North America 5.4.0* was selected, the default *0 Balanced (Neutral) was* selected, and Idaho *was* selected in the *Select by Region* drop-down list. In that list of bats of Idaho, Townsend's big-eared bat and western small-footed myotis were selected. After calls were classified by Kaleidoscope, the INL contractor manually vetted all calls for both species (Ednie et al. 2021, López-Baucells et al. 2021, Richardson et al. 2021).

Interest exists in developing long-term acoustic monitoring of bats (Frick 2013, Nocera et al. 2019), and deploying several stationary detectors is valuable for understanding bat activity at a landscape scale (Stahlschmidt and Bruhl 2012). With the arrival of WNS in western North America (Lorch et al. 2016), and with the fungus that causes WNS now documented in Minnetonka Cave in southern Idaho, which is about 190 km from the INL Site, it is important to understand winter cave-exiting behavior of bats (Bernard and McCracken 2017, Reynolds et al. 2017). The comparison between the data classified by Kaleidoscope and data classified by using AnaLookW had strong positive correlation values. Kaleidoscope does not require as much time to analyze data and can provide trends in the number of call files across time. Such data will provide a long-term baseline dataset of bat cave-exiting behavior, which can be used in future analyses to quantify the potential impact of WNS on these species when this disease arrives on the INL Site (Whiting et al. 2021).

The INL contractor then correlated the number of files and pulses for Townsend's big-eared bat and western small-footed myotis classified by Kaleidoscope compared with those files and pulses classified by AnaLookW. That preliminary analysis indicated that the number of files and pulses analyzed using AnaLookW for Townsend's big-eared bats and western small-footed myotis were strongly correlated with the number of files and pulses analyzed using Kaleidoscope (Figure 2).

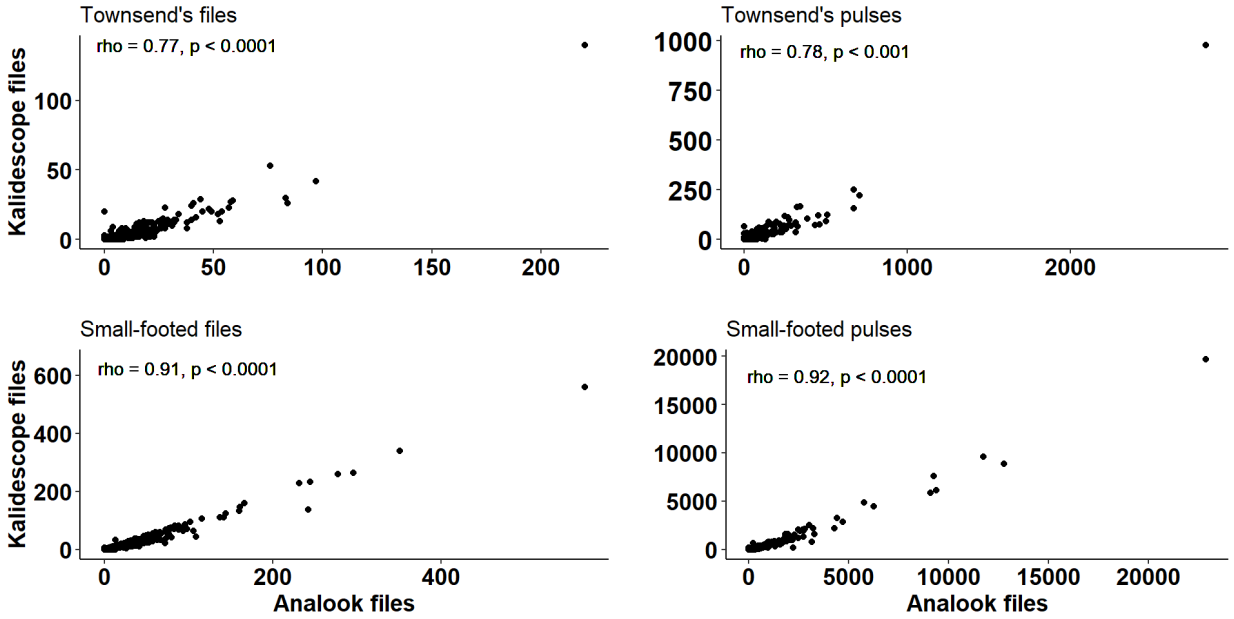


Figure 2. Correlation between number of files and pulses classified by Kaleidoscope and those classified by AnalookW in 8 caves on the Idaho National Laboratory Site from 2011 to 2018. Strong positive correlation values (rho) existed for each comparison.

3.2.2 Spring, Summer, and Autumn Passive Acoustic Monitoring

Monitoring bats acoustically throughout the year is important and can provide data on how WNS and wind-energy development affect bat populations (Brooks 2011, Dzal et al. 2010). Anabat SD2 and Anabat Swift detectors were placed from 1 May to 30 September 2022 at eight facilities [Advanced Test Reactor -Complex (ATR), Central Facility Area (CFA), Critical Infrastructure Test Range Complex (CITRC), Idaho Nuclear Technology and Engineering Center (INTEC), Material and Fuels Complex (MFC), Naval Reactor Facility (NRF), Radioactive Waste Management Complex (RWMC), and Test Area North (TAN)] and seven caves (Middle Butte, Rattlesnake, East Boundary, Aviators, Jensen's, Obscenity Snake Pit, and North Tower Wackenhut caves). Those detectors documented the occurrence of bat species at those features during the non-hibernation season. For facility acoustic monitoring, Anabat SD2 detectors were oriented to maximize detection of bats at areas likely to concentrate bat activity (e.g., facility surface-water features such as sewage lagoons). For cave acoustic monitoring, Anabat Swift detectors were set, and the microphones were oriented to maximize detection near the area of interest (i.e., cave entrance or crater) at each site while trying to avoid recording near-ground noise and echoes.

Kaleidoscope was used for species identification to analyze bat occurrence at a facility or a cave (Clement et al. 2022, López-Baucells et al. 2021, Laverty and Berger 2022). Under the signal parameter tab, the minimum and maximum frequency range was set at 14 to 120 kHz. In the *Auto ID for Bats* tab, *Bats of North America 5.4.0* was selected, the default *0 Balanced (Neutral)* from the drop-down list was selected, and Idaho was selected in the *Select by region* drop-down list. In that list of bats of Idaho, the following species that were documented in the 2020 update of the INL Site Bat Protection Plan were selected: Townsend's big-eared bat, big brown bat (*Eptesicus fuscus*), hoary bat (*Lasiurus cinereus*), silver-haired bat (*Lasionycteris noctivagans*), California myotis (*M. californicus*), western small-footed myotis, long-eared myotis (*M. evotis*), little brown myotis, and Yuma myotis (*M. yumanesis*). Those species were selected, because from May to September 2017 to 2019, Anabat detectors recorded 612,956 files of those species on the INL Site, and automated acoustic identification is improved by only considering species that occur in the study area (Fraser et al. 2020).

After the files were filtered by facility and cave in Kaleidoscope, the nights during which a species was present was quantified using the maximum likelihood estimator produced by Kaleidoscope (i.e., if the *p*-value was < 0.05 that species occurred on that night). Each species' nightly presence was divided by the number of nights detectors functioned for each facility and cave and then were plotted. Across those years, Anabat units functioned for a mean of 39 nights (*SD* = 34.8, range = 0 to 105 nights) at facilities and 113 nights (*SD* = 46.3, range = 32 to 153 nights) at caves. Kaleidoscope documented 315 detector nights that species were present across all facilities and 683 detector nights that species were present across all caves. Detectors did not properly function at Aviators Cave and INTEC. The presence of seven species predominately at facilities were recorded (Figure 3a) and the presence of nine species at caves (Figure 3b). Little brown myotis and western small-footed myotis had the highest number of nights of occurrence at all facilities, except for CITRC, MFC, and TAN. Silver-haired bats were the second most recorded bat at CITRC and TAN, and hoary bats were the second most recorded bat at MFC (Figure 3a). Little brown myotis were recorded at all caves, and western small-footed myotis were recorded the most at 5 of 6 caves (Figure 3b).

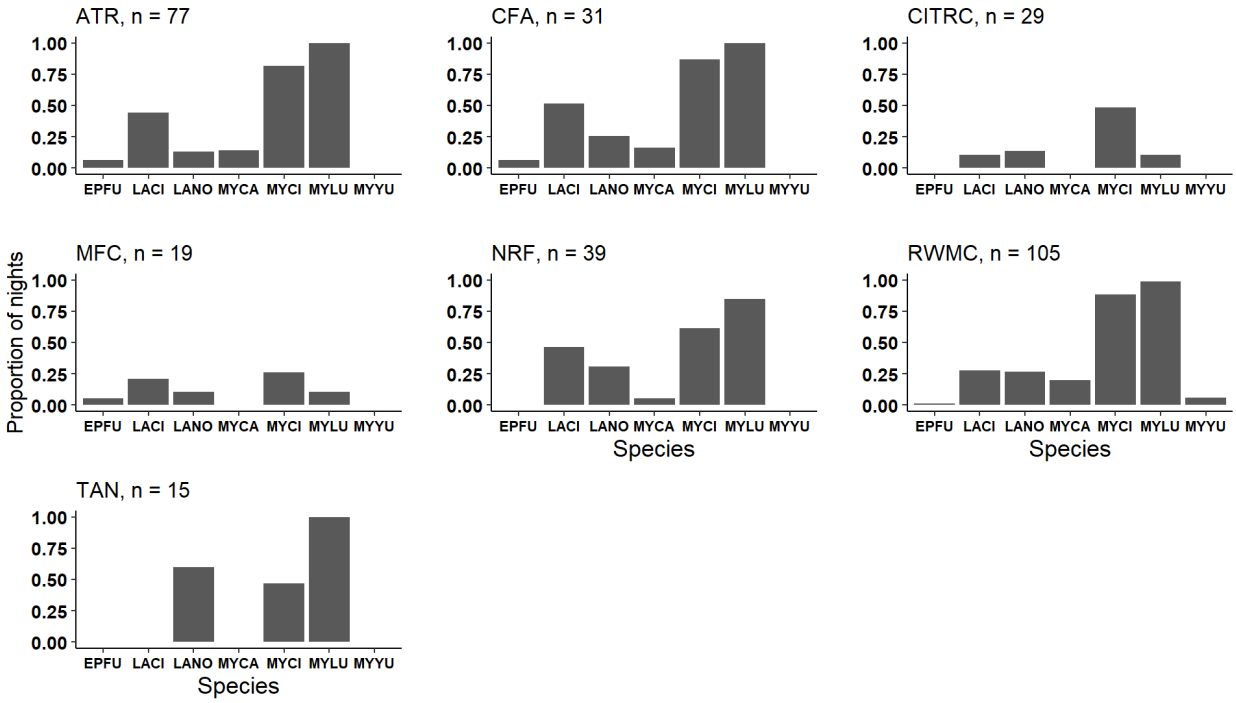


Figure 3a. Proportion of nights that bat species were documented at Idaho National Laboratory Site facilities during May to September 2022. The number of nights sampled is denoted by the n after the cave name. Species are identified as the following: big brown bat (EPFU), hoary bat (LACI), silver-haired bat (LANO), California myotis (MYCA), western small-footed myotis (MYCI), little brown myotis (MYLU), and Yuma myotis (MYYU).

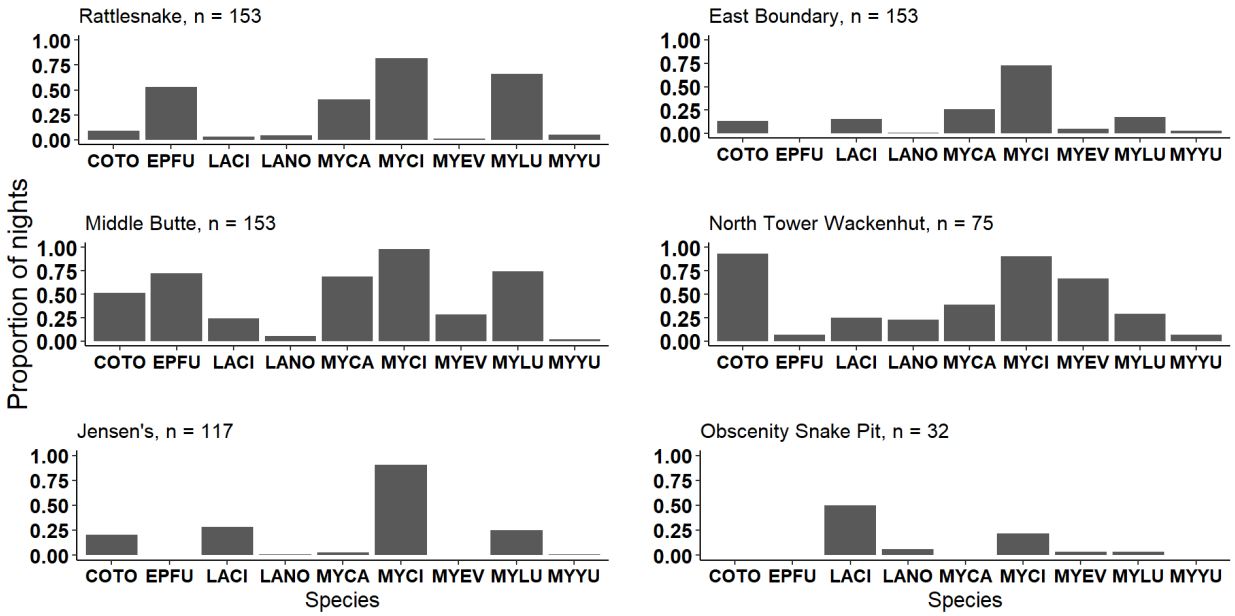


Figure 3b. Proportion of nights that bat species were documented at Idaho National Laboratory Site caves during May to September 2022. The number of nights sampled is denoted by the n after the cave name. Species are identified as in the caption for Figure 3a along with Townsend's big-eared bat (COTO) and long-eared myotis (MYEV).

3.3 Participation in The North American Bat Monitoring Program (NABat)

The NABat program is a multiagency, multinational effort to standardize monitoring and management of bat species across several taxa (Loeb et al. 2015). NABat sampling and monitoring is divided across North America as a series of 10 x 10 km grid cells (Loeb et al. 2015), grid cells are then prioritized at a state level and each grid cell is subsequently split into four quadrants. Two grid cells are located on and near the INL Site and a stationary acoustic survey point was identified within each of those quadrants (Loeb et al. 2015). Anabat Swift detectors were set at eight locations on and near the INL Site during 2022 (Figure 4). To document the occurrence of bat species at those locations, Kaleidoscope was used for automated species identification (Clement et al. 2022, López-Baucells et al. 2021, Laverty and Berger 2022). Under the signal parameter tab, the minimum and maximum frequency range was set at 14 to 120 kHz. In the *Auto ID for Bats* tab, *Bats of North America 5.4.0* was selected, the default *0 Balanced (Neutral)* was selected from the drop-down list, and Idaho was selected in the *Select by region* drop-down list. Files were filtered by sampling location in Kaleidoscope, and the number of nights in which a species was present was quantified using the maximum likelihood estimator produced by Kaleidoscope.

During 2022, detectors recorded the presence of big brown bats, hoary bats, California myotis, western small-footed myotis, and little brown myotis at the eight sampling locations. These data have been sent to the Bat Hub at Oregon State University and to the IDFG to help with producing range-wide occupancy probability predictions for those bat species.

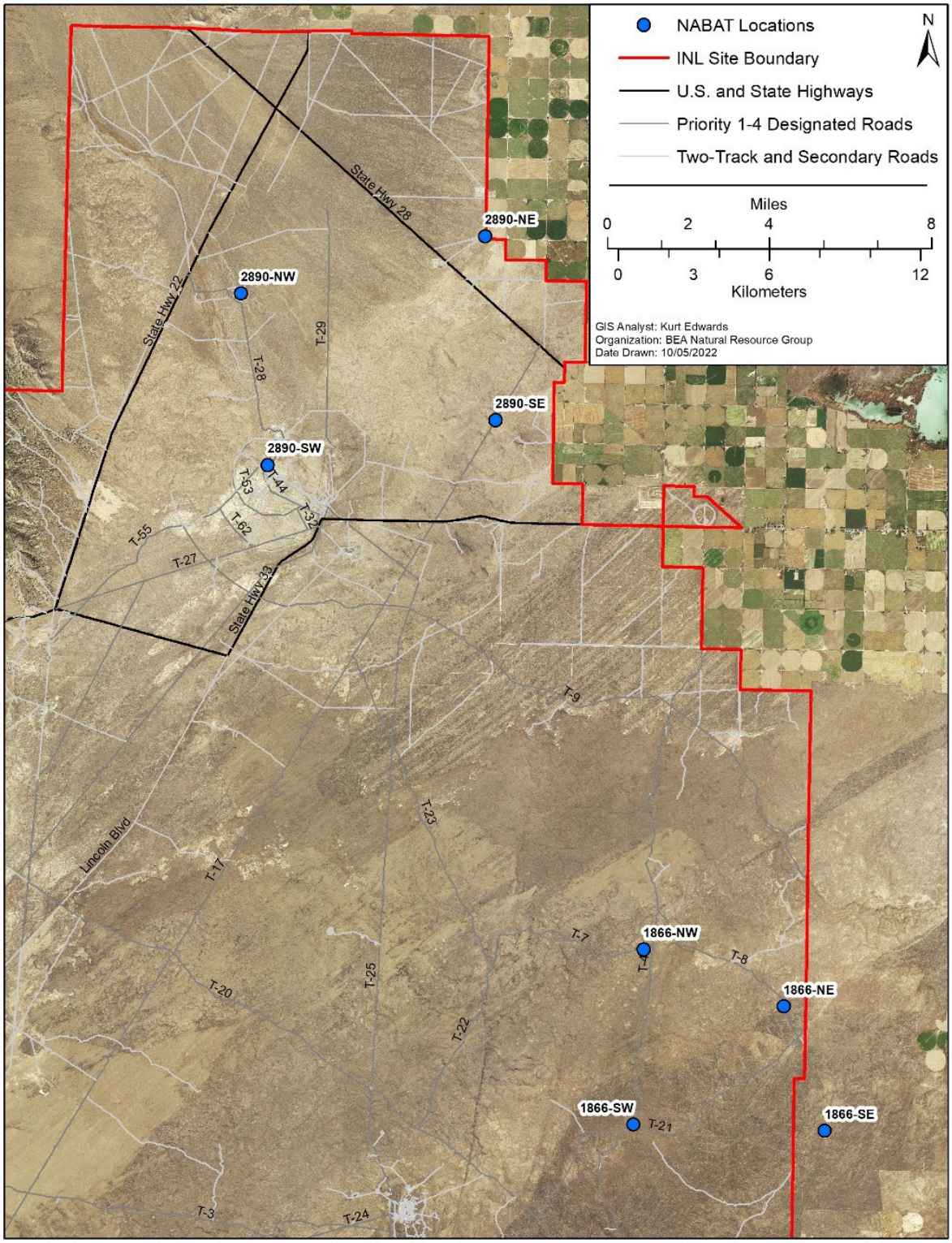


Figure 4. Locations of stationary detectors for NABat monitoring to document the occurrence of bat species on and near the Idaho National Laboratory Site during August 2022.

3.4 White-Nose Syndrome Surveillance

WNS is a recent threat to many bats that hibernate in caves (Hoyt et al. 2021, Frick et al. 2010, Knudsen et al. 2013) and has killed over five million bats in seven species (Bernard and McCracken 2017, Hoyt et al. 2021). Many common bat species could be at risk of significant declines or extinction due to this disease (Hammerson et al. 2017). WNS has primarily been a disease occurring in the eastern USA (Ingersoll et al. 2016, Langwig et al. 2015, Reynolds et al. 2017), however, WNS is now in the western USA (Lorch et al. 2016). In October 2021, *Pseudogymnoascus destructans,* the fungus that causes WNS, was documented in Minnetonka Cave in southern Idaho, which is about 118 miles (190 km) southeast of the INL Site. Under the direction of the IDFG, increased surveillance for the fungus and the disease will need to occur on the INL Site (Table 1). Biologists from IDFG are collaborated with regarding WNS sampling of bats on the INL Site. This is done by sending the final copy of the INL Site Bat Protection Plan to biologists from IDFG. Those biologists are also invited to our annual meeting to discuss the Bat Protection Plan. At that meeting, the potential sampling of caves and bats on the INL Site for WNS surveillance is discuss with the biologists from IDFG and will be conducted based on their schedule.

Table 1. Bat species and potential for these species to be infected with the fungus Pseudogymnoascus destructans (Pd) that causes White-nose Syndrome.

Common name	Potential or confirmed WNS susceptible species[1]
Big brown bat	Yes
Hoary bat	No
Little brown myotis	Yes
Silver-haired bat	*Pd* positive
Townsend's big-eared bat	*Pd* positive
Western long-eared myotis	Yes
Western small-footed myotis	*Pd* positive
California myotis	Yes
Fringed myotis	Yes
Long-legged myotis	Yes
Yuma myotis	Yes

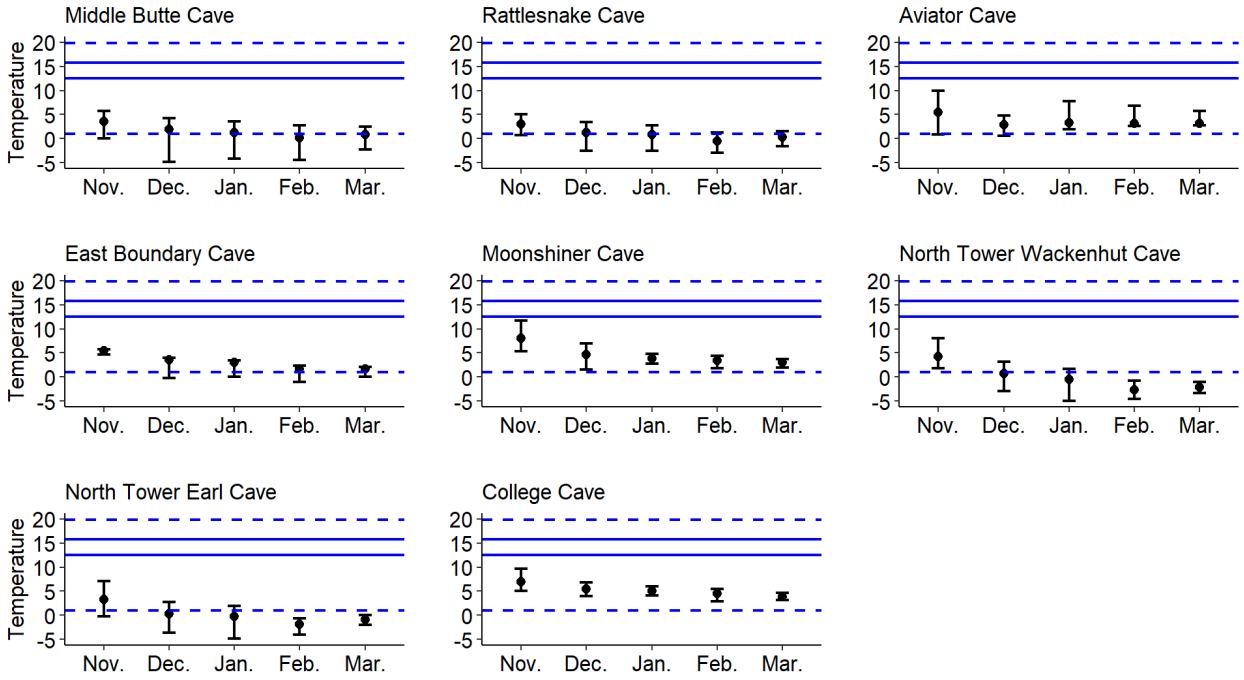
[1] https://www.whitenosesyndrome.org/static-page/bats-affected-by-wns

3.4.1 Cave Temperature and Humidity

The growth of *Pseudogymnoascus destructans* is restricted by cave temperature and humidity (Torres-Cruz et al. 2019, Vanderwolf et al. 2012, Verant et al. 2012). Quantifying temperature and humidity in caves on the INL Site are important for understanding the potential for WNS to become established in caves. HOBO data loggers were placed in eight hibernacula on the INL Site from 1 November 2022 to 31 March 2023. Data loggers were placed in areas where bats had been observed previously during

hibernacula surveys. HOBO loggers recorded temperature (°C) and humidity (% relative humidity) every 30 minutes. A mean, minimum, and maximum temperature for each month by cave was then computed. All caves on the INL Site had temperatures that were below the optimal growth for *Pseudogymnoascus destructans,* especially during January to March (Figure 5). The fungus also needs high levels of relative humidity for optimal growth (> 81%) (Torres-Cruz et al. 2019, Marroquin et al. 2017). College cave (94%) had humidity levels that would support optimal growth of the fungus. Middle Butte (74%), Moonshiner (78%), and North Tower Wackenhut (79%) caves had high humidity levels compared with the rest of the caves and could support limited growth of *Pseudogymnoascus destructans* (Marroquin et al. 2017). Swabbing in these caves would be important to do in the future. All other caves did not have humidity levels that would support growth of *Pseudogymnoascus destructans.*

Figure 5. Mean (black dot), minimum, and maximum (error bars) temperatures (°C) by month in eight caves on the Idaho National Laboratory Site from November 2022 to March 2023. The solid blue lines



represent the optimal range of temperatures for growth of Pseudogymnoascus destructans, while the dashed blue lines represent the range of temperatures for active growth of Pseudogymnoascus destructans (Verant et al. 2012).

3.5 Carcass Recovery and Assessment

Occasionally, bats will take refuge at INL Site facilities and then die. Often INL Site workers discover a bat carcass on the floor or walls in facility buildings or outside in areas near facilities (DOE 2018) and contact the BEA Natural Resource Group. When contacted, carcasses are collected and stored to send later to a qualified laboratory to assess their level of radionuclides (DOE 2018). During 2022, 34 dead bats (10 silver-haired bats, 15 western small-footed myotis, and 9 little brown myotis) were collected. Five or more bat carcasses of any species at the same time in a single location were never recorded, which would have been classified as a die-off, and would have triggered a notification to local and state biologists from the IDFG to begin investigating the cause of death (DOE 2018).

The 34 bats collected in 2022 were sent to GEL Laboratories (Charleston, South Carolina) to be analyzed for gamma-emitting radionuclides, specific alpha-emitting radionuclides, and for strontium-90, which is a beta-emitting radionuclide. The following radionuclides were detected in at least one sample during 2022: Cesium-137, Cobalt-60, and Strontium-90. Cesium-137 is ubiquitous in the environment because of fallout from historical nuclear weapons tests. Strontium-90 is another fallout radionuclide. Cobalt-60, which is a fission product, may indicate that the bats visited radioactive effluent ponds on the INL Site, such as at the ATR Complex ponds. The maximum dose received by bats at the INL Site was estimated to be 0.0006 rad/d (0.006 mGy/d) in 2022. The calculated doses are well below the threshold of 1 rad/d (10 mGy/d). Based on these results, members of the bat population at the INL Site receive an absorbed dose that is within the DOE standard established for the protection of terrestrial animals (DOE 2023). Since 2018, 115 bat carcasses collected at INL Site facilities were submitted to be analyzed for gamma-emitting radionuclides, specific alpha-emitting radionuclides, and for strontium-90. All the samples have come back with calculated doses within the DOE standard established for terrestrial animals.

3.6 Relocating Live Bats

Live bats are occasionally located in buildings, sheds, or storage facilities on the INL Site, especially during summer when bat pups are becoming independent and during fall migration when bats are shifting from summer to winter habitats. When a bat was found in an area where it was safe and not creating a nuisance to INL Site workers or disrupting work, the bat was left alone and allowed to leave on its own accord. If a bat was found in an area where it was at risk of injury or was disrupting work, it was relocated from the area following approved guidelines (INL2022, INL 2023, DOE 2018, White-nose Syndrome Conservation and Recovery Working Group 2015). In 2022, seven bats were located in or near facilities. Two bats were in locations where they could be left alone and thus left on their own. In five other instances, bats were relocated to vegetation outside of the building.

3.7 Public Outreach

Public outreach is a great way to help educate the public about bats and the threats that impact bats. In 2022, the INL contractor conducted public outreach through writing publications, providing training and presentations, and collaborating with local universities. A list of publications, presentations, posters, trainings, and collaborations can be found in Appendix A.

One peer-reviewed paper was published, and one manuscript is in preparation that was written in collaboration with professors at Brigham Young University-Idaho and Idaho State University. Two presentations and one poster were presented at local and national scientific meetings.

The INL biologists also presented to over 200 people at the Idaho Falls Zoo Bat Nights. A website was developed that discusses the INL Site's bat work with the Idaho Falls Zoo. In collaboration with the Idaho Falls Zoo an Anabat SD2 bat detector was deployed and monitored at the zoo. *All About Bats*, *Idaho Ecology*, and *Green Energy* presentations were given to 270 students in classrooms in Idaho Falls. Those presentations also occurred during a summer STEM Scholars Camp and at a workshop held in conjunction with the Museum of Idaho at Harriman State Park during the bat segment of the wildlife workshop. One-hundred and seventy teachers were taught during Bring Idaho Alive workshops about local bats, conservation, and acoustic monitoring. Training was provided on the basics of bat acoustic detectors to 35 biology students at Brigham Young University-Idaho. Fundamental skills were taught for analyzing bat call files using the Kaleidoscope software.

A collaboration was made with a student on a M.S. project at Idaho State University. Efforts included acoustically monitoring with stationary detectors from June to September along the South Fork of the Snake River, and in the Sand Creek Desert, for little brown myotis, as well as for the other six bat species in that area—all of which are species of conservation concern in Idaho (IDFG 2022b)—to quantify peaks

and hot spots of bat activity using acoustical detectors (López-Baucells et al. 2021, Milchram et al. 2020). Data collected from those areas will be compared with similar data collected on the INL Site.

This project will initiate substantial monitoring of bat habitat use in southeastern Idaho and provide baseline data using activity indices in several habitats before the potential impact of WNS in this area. Data from those surveys will be provided to the IDFG, USFWS, DOE-ID, and other collaborators for the management and conservation of bats and their habitat. These data can then be used by those agencies to prioritize where, when, and how often to sample to detect the potential arrival of WNS in these areas.

3.8 Surveys of Bridges and Culverts

Bridges and culverts provide important roosting habitat for bats (Adams 2003). On 24 August 2022, preliminary surveys were conducted of 22 bridges and culverts for bats on the INL Site using protocols adopted by the USFWS (USFWS 2020). Bridges and culverts were searched for roosting bats, guano, discarded insect wings, and staining on the walls and ceilings of structures from urine and feces (USFWS 2020). Of the 22 structures surveyed, no roosting bats were observed, but six structures (bridge on Lincoln Blvd. north of NRF, culverts on Lincoln Blvd. near INTEC, bridge on Hwy 20 near rest stop, culverts at the Big Lost River diversion, EBR-I guard house and a rock culvert south of Farragut Blvd. east of RWMC) with guano, three structures with discarded insect wings, and one structure with staining on the walls and ceilings were observed. It is proposed to continue surveying those features where bat sign was documented in 2022. This surveying would include night-time visual surveys for roosting bats, deploying Anabat detectors near bridges and culverts, and potentially setting mist nets at these features.

4.0 Assess Conservation Measures for Bats

The INL Site Bat Protection Plan ensures protection of sensitive bat resources through adherence to recommended conservation measures. Conservation measures in the Bat Protection Plan were developed in collaboration with IDFG and USFWS bat biologists (Table 2). Some of those measures have been considered during project planning and NEPA analysis on the INL Site. After the Bat Protection Plan was finalized in 2018, INL contractors began implementing management recommendations into planning and daily work activities. Procedural documents have utilized the Bat Protection Plan to provide guidance to INL managers and personnel regarding encounters with live or dead bats. Those documents also address seasonal activities that may affect summer roosts.

The Bat Protection Plan also provides guidance in the form of conservation measures for certain activities proposed under recent NEPA evaluations. The Environmental Review Process at the INL determines the level of review for every proposed action and provides directions for compliance with all associated environmental aspects. Most proposed actions at the INL only meet the threshold for a categorical exclusion and are analyzed using an Environmental Compliance Permit (ECP). Each ECP is reviewed by Technical Points of Contacts (TPOCs) to ensure all aspects relating to their field are addressed appropriately. The NRG TPOCs who review ECPs, are responsible for including language associated with the conservation measures outlined in the Bat Protection Plan. There were no proposed actions in 2022 that required review beyond that of an ECP (i.e., Environmental Assessment or Environmental Impact Statement).

Table 2. Threats affecting bats and their habitat that are most likely to occur on the INL Site, recommended conservation measures (DOE 2018), and assessment of those measures on the INL Site from March 2022 until March 2023.

	Threats	Recommended Conservation Measures	Assessment of Conservation Measures
	Disturbing hibernating bats and destruction/modification of hibernacula and summer roosts		
1	Recreational caving/unlawful entry into caves	• Identify hibernacula and restrict access to these features.	• No known recreational or unlawful entry occurred in caves.
2	Research, monitoring, and inventory	• Establish a permit process for research required cave entry and bat handling activity. • Hibernacula surveys should be conducted every other year; surveys should be conducted with caution, quickly, and quietly.	• Biologists of the BEA NRG program obtained a permit (#2022-1) to enter caves to conduct hibernacula surveys. • Biologists of the BEA NRG program used caution when conducting surveys and performed counts quickly and quietly.
3	Activities that produce loud noises near hibernacula and important summer roosts	• Limit activities that produce continuous noise ≥ 75 decibels within a 1-mile (1.6 km) radius of hibernacula and important summer roosts.	• No loud noise producing activities were conducted near known hibernacula or important summer roosts.
4	Explosives near hibernacula and important summer roosts	• Avoid blasting within a 0.75 mile* (1.2 km) radius of hibernacula and important summer roosts.	• No blasting occurred within 0.75 miles of known hibernacula and important summer roosts.
5	Facility construction activities	• Avoid construction activities near summer roosts.	• No known summer roosts were disturbed because of construction around facilities.
6	Removing roost trees	• Avoid removing living or dead trees.	• No known roost trees near facilities, or outside of facilities, were removed.
7	Removing anthropogenic roosting structures	• If bats are using buildings, sheds, or storage facilities that are proposed to be removed, do such outside of the maternity and hibernation season.	• No buildings, sheds, or storage facilities were removed. BEA Biologists were contacted about the D&D of S1W at NRF. A BEA Biologist did a search of S1W looking for roosting bats and any signs bat use. The biologist also advised conducting weekly searches.

Table 2. continued.

8	Removing or modifying bridges, culverts, and underpasses	• Examine if bats are roosting on these features prior to construction activities.	• No bridges, culverts, or underpasses were removed or modified.
9	Pesticides, herbicides, and vegetation removal	• Avoid or minimize pesticide use and vegetation removal near roosts and important foraging or other bat activity areas.	• No pesticide and herbicide application or mechanical vegetation removal occurred within 150 feet of caves and near important foraging areas.
	White-nose syndrome		
10	Recreational caving/unlawful entry into caves	• Identify hibernacula and restrict access to these features.	• No known recreational or unlawful entry occurred in caves.
11	Research, monitoring, and inventory	• Minimize the potential spread of WNS.	• Biologists of the BEA NRG program obtained a permit (#2022-1) to enter caves to conduct hibernacula surveys. All personnel followed the most recent USFWS WNS protocols when entering caves and when decontaminating equipment after exiting caves.
	Loss or modification of habitat around caves		
12	Conversion or destruction of vegetation	• Limit wildland fires near caves. • No prescribed burning of native vegetation within a 5-mile (8 km) radius of hibernacula. • No large scale (> 10 acres [4 ha]) modification of native vegetation in undisturbed areas within a 1.5-mile (2.4 km) radius of hibernacula.	• No wildland fires occurred near caves. • No prescribed burns occurred on the INL Site. • No modification of native vegetation happened near hibernacula.
13	Disposing of vegetation or soil near caves	• Avoid disposing of vegetation or soil within a 33-yard (30 m) radius of a cave.	• No vegetation was disposed of near caves.
	Environmental contaminants and wind-energy development		
14	Environmental radionuclides	• Assess radionuclide levels in dead bats.	• See section 3.5 of this report.

Table 2. continued.

15	Pesticide, herbicides, and vegetation removal	• Avoid or minimize pesticide use and vegetation removal near roosts and important foraging or other bat activity areas.	• No pesticides or herbicides were used around buildings and wastewater ponds.
16	Wind-energy development	• Follow the USFWS Land-Based Wind Energy Guidelines.	• No wind-energy facilities were constructed on the INL Site.

5.0 Recommendations for Additional Studies, Management Actions, and Plan Revisions

5.1 Additional Studies

5.1.1 Hibernacula Surveys around Middle Butte

Acoustic detectors are effective at identifying bat species across habitat types (Britzke and Murray 2000, Miller 2001), and these devices have been used extensively to study bat winter ecology (Bernard and McCracken 2017, Klüg-Baerwald et al. 2016, Whiting et al. 2022). Little is known about bat hibernation behavior, especially in natural, rock-crevice hibernacula (Johnson et al. 2017, White et al. 2020). Middle Butte is an elevated block of basalt flows (Spear and King 1982) that provides a diverse area of potential bat habitat and hibernation locations in the rock fall. The rock fall in the butte consists of large elevation and aspect gradients that may comprise temperature and humidity regimes that can be suitable for hibernation. In summer 2022, a search was conducted around Middle Butte for potential roosting and hibernation habitat for bats in the rock fall. Several areas were identified that could be used for roosting and hibernation sites on the north, northeast, and west sides of the butte. It is proposed to set Anabat detectors around Middle Butte during winter 2024/2025 (November 1 to March 31) in those areas to document if the rock fall around the butte is used by hibernating bats. It is also proposed to set Anabat detectors around Middle Butte in those areas during maternity season (1 June to 31 August) to document if the rock fall around the butte is used by lactating females.

5.1.2 Setting Mist Nets at Facilities and Caves

Capturing bats in mist nets is an important way to gather information on species confirmation, richness, and diversity in an area, as well as to determine sex, age, and reproductive status of bats (O'Farrell and Gannon 1999, Francl et al. 2012). Mist netting for bats has occurred historically on the INL Site (Whiting et al. 2015). Current data for bat species occurring around facilities and caves are needed, this is especially true with the impending decision regarding little brown myotis and the potential for this species to be listed under the ESA. It is proposed to mist net around the eight facilities and three caves—Middle Butte, Rattlesnake, and Aviators caves (the three largest hibernacula on the INL Site). This trapping will occur from 1 June to August 31 on nights with suitable moon phase. When capturing bats, a determination will be made on sex, species, and if females are lactating (Gruver and Keinath 2006, Holloway and Barclay 2001, Krochmal and Sparks 2007). Doing such will provide important data for the different species occurring around facilities and caves and will help biologists at the INL Site understand the use of facilities and caves by lactating females.

5.1.3 Swabbing bats on the INL Site

Coordinate with IDFG at our annual meeting about swabbing.

5.2 Management Actions

With the potential listing of the little brown myotis under the ESA, it is planned to produce an INL Site-wide training regarding the basics of the ESA, the management regulations of a listed species under that Act, and the handling and transporting of little brown myotis that are found on the INL Site once the bat is listed. With the arrival of the fungus that causes WNS in Idaho, training will be conducted to provide updated information of WNS and its arrival in Idaho and reinforce the need to eliminate unlawful entry into caves on the Site to help limit the spread of WNS.

5.3 Plan Revisions

There are no major plan revisions proposed at this time. However, the Bat Protection Plan references the Environmental Surveillance, Education, and Research program and not the BEA NRG program. The Bat Protection Plan (2018) should be updated by fixing the references to the INL Contractor.

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Appendix A. Public Outreach in 2022

Publications

Published

Whiting, J. C., B. Doering, and K. Aho., 2022, "Can acoustic recordings of cave-exiting bats in winter estimate bat abundance in hibernacula?" *Ecological Indicators* 137:108755. https://www.sciencedirect.com/science/article/pii/S1470160X22002266

In preparation

Whiting, J. C., B. Doering, and K. Aho, In preparation, "How many nights should acoustic detectors be set to estimate cave-exiting behavior of hibernating bats?" *Wildlife Research*.

Presentations and posters

Whiting, J. C., 2022, Bat Night 2022: Bat Conservation and a "Chiropterarium" at the Idaho Falls Zoo, Idaho Falls, ID.

Whiting, J. C., 2022, Update on the Idaho National Laboratory Site Bat Protection Plan. Idaho Chapter of the Wildlife Society Annual Meeting, virtual meeting.

Whiting, J. C., B. Doering, and K. Aho, 2022, Can acoustic recordings of cave-exiting bats in winter estimate bat abundance in hibernacula? 50th North American Symposium for Bat Research an 19th International Bat Research Conference, Austin, TX.

Local Presentations

Idaho Falls Zoo

Two bat nights were organized for more than 200 people to discuss bat research, as well as bat acoustic monitoring and conservation at the Zoo, on the INL Site, and throughout Idaho. Website about bat work conducted on the INL Site: Bat Night at the Zoo| Idaho Falls, ID (idahofallsidaho.gov)

Local Elementary and High Schools

All About Bats, *Idaho Ecology*, and *Green Energy* presentations were given to 270 students in classrooms in Idaho Falls. Those presentations also occurred during a summer STEM Scholars Camp and at a workshop held in conjunction with the Museum of Idaho at Harriman State Park during the bat segment of the wildlife workshop.

Elementary and High School Teachers' Workshops

One-hundred and seventy teachers were taught during Bring Idaho Alive workshops about local bats, conservation, and acoustic monitoring.

Collaboration with Local Universities

Training was provided on the basics of bat acoustic detectors to 35 biology students at Brigham Young University-Idaho. Fundamental skills were taught for analyzing bat call files using the Kaleidoscope software.

A collaboration was made with a student on a M.S. project at Idaho State University. Efforts included acoustically monitoring with stationary detectors from June to September along the South Fork of the Snake River, and in the Sand Creek Desert, for little brown myotis, as well as for the other six bat species in that area—all of which are species of conservation concern in Idaho (IDFG 2022b)—to quantify peaks and hot spots of bat activity using acoustical detectors (López-Baucells et al. 2021, Milchram et al. 2020). Data collected from those areas will be compared with similar data collected on the INL Site.

This project will initiate substantial monitoring of bat habitat use in southeastern Idaho and provide baseline data using activity indices in several habitats before the potential impact of WNS in this area. Data from those surveys will be provided to the IDFG, USFWS, DOE-ID, and other collaborators for the management and conservation of bats and their habitat. These data can then be used by those agencies to prioritize where, when, and how often to sample to detect the potential arrival of WNS in these areas.