Collaboration with wildlife rehabilitation centers to enhance bat care, research, and conservation

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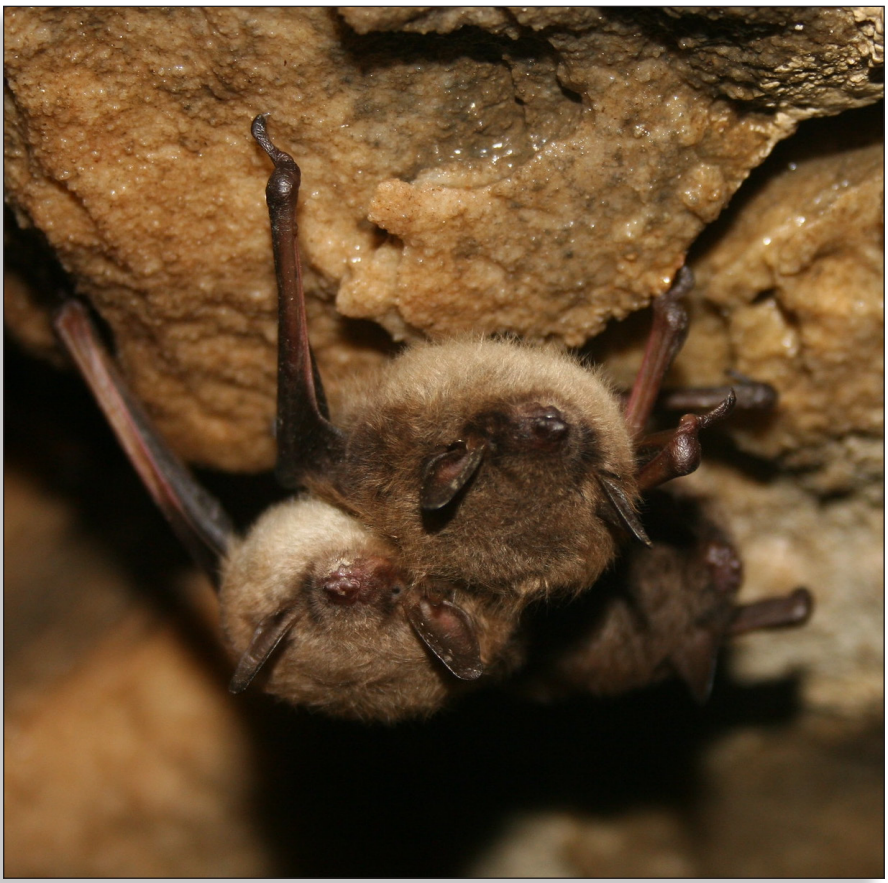

Little brown bats (*Myotis lucifugus*).

Introduction

Bats are commonly misunderstood and feared by the public. Thought to be evil, flying rodents that get caught in one's hair, suck blood, and transmit diseases,[1,2,3] they garner mostly negative attention. Nevertheless, their important roles in ecosystems, remarkable behaviors, and conservation threats are increasingly studied and the subject of improved public outreach.[3]

Although bats face many threats such as habitat loss and degradation, roost disturbance, and persecution, new threats are emerging.[4,5] The development of alternative energy technologies, for example, has sometimes amplified previous threats, and has caused new problems such as barotrauma and direct mortality from collisions with wind turbine blades.[6] Diseases such as white-nose syndrome have caused bat populations in North America to plummet, in some cases more than 90%.[7] Climate change is a pervasive threat, reducing reproductive success and habitat availability through alteration of temperature regimes, and potentially from more frequent and severe wildfires.[8] Interactions with non-native species, such as domestic cats, also contribute to bat injuries and mortality.[9–12] As a result, wildlife rehabilitation centers (WRC) across North America are seeing larger numbers of bat admissions.[13,14]

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ABSTRACT: Bats are frequent patients at wildlife rehabilitation centers (WRCs) and pose unique challenges for their care. While they are taxonomically and ecologically diverse and face a wide variety of anthropogenic threats, their behavior, ecology, and animal husbandry requirements are poorly understood. Consequently, so are the best practices for their care and conservation. We review the available literature and summarize current opportunities and challenges for WRCs to collaborate with researchers, government agencies, academic institutions, community members, and other conservation organizations to enhance our knowledge of bats. Recognizing the opportunities WRCs offer by having wild bats under their care and by entering their data into national databases, collaborators could advance knowledge of bat biology rapidly. Collaborators, in turn, when recognizing the logistical constraints many WRCs face, could contribute to improvements to the rescue, care, and post-release survival of injured bats. We offer recommendations for collaborative opportunities and suggest potential research questions addressable with bats held at WRCs.

KEYWORDS: acoustic monitoring, bat, biotelemetry, Chiroptera, citizen science, post-release survival, wildlife rehabilitation, WILD-ONe database, zoonotic disease surveillance.

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J. Wildlife Rehab. 43(1):7–16. ©2023 The International Wildlife Rehabilitation Council.

Wildlife rehabilitation centers are playing an increasingly important role in bat conservation, particularly from the data collected at the centers and the vital role the centers play in public engagement and education. As one example, over a fifteen-year period (2005–2020), a total of 777 bats constituting seven species were admitted to the Ohio Wildlife Center in central Ohio, of which 33% were rehabilitated and released.[14] Because many WRCs receive bats, we argue that WRCs have an opportunity to expand their roles in bat research and conservation, as a wide variety of data can be collected from patients and shared with research communities. WRCs also have unique opportunities to engage the public in bat conservation. WRCs tend to focus on care of injured bats and can contribute basic knowledge about care and recovery. Because bats generally have low fecundity and relatively slow reproductive rates, WRCs may also have positive impacts on local bat populations under certain conditions, through successful rehabilitation and release of healthy animals back to the wild.[15] Simulation models showed a reduction of adult mortality via rehabilitation partially abated extinction risks for bats with small populations.[15] Despite the promise, the potential for WRCs to contribute to population-level effects needs further empirical evaluation.

Nearly all WRCs collect data valuable for improvement of our scientific understanding of basic biology and mortality risks faced by bats. With animals in hand, WRCs can contribute to pathogen surveillance, quantification and characterization of injuries, identification of sites where human disturbance of bats is frequent, and other emerging threats. In this article, we highlight opportunities for collaboration between WRCs, researchers, and conservationists interested in bats and their threats, building on the existing strengths of WRCs and revealing directions for enhancing their contributions to knowledge of bats.

Methods

We searched scientific databases for peer-reviewed scholarship, including Google Scholar, Researchgate.net, JSTOR, Web of Science, and the Oregon State University library search engine "1search." Keywords used to find relevant sources included: wildlife rehabilitation, wildlife management, wildlife database, bat conservation, bat rehabilitation, human–wildlife conflicts, biodiversity data, and conservation networking. Primary sources were included if they had direct application to bat research or rehabilitation. In addition, we supplemented information with personal observations and direct communications with rehabilitation facilities, including the Ohio Wildlife Center in Columbus, Ohio and the Lake Erie Nature and Science Center in Cleveland, Ohio.

Background of wildlife rehabilitation

Wildlife rehabilitation started as a grassroots movement in the 1970s with private citizens caring for injured, ill, and orphaned animals in their own backyards.[16,17] Since then, larger and more organized centers have become commonplace, many of which operate as non-profit organizations driven or dependent on volunteers. Regulation of these centers varies, frequently following care standards set by local, state, and federal government agencies, as is typical in the U.S. Although the mission of individual centers may vary, most wildlife centers follow the International Wildlife Rehabilitation Council (IWRC) definition of wildlife rehabilitation, "The treatment and temporary care of injured, diseased, and displaced indigenous animals, and the subsequent release of healthy animals to appropriate habitats in the wild."[16] Additionally, at least in the United States, WRCs are required to follow a set of minimum standards when intaking, treating, and caring for wildlife patients. This includes collecting information from the presenter such as name, contact information, circumstance of rescue including location, and health risks to the admitting person (e.g., were they bitten or scratched by the animal). Many WRCs contribute data to online databases such as WILD-ONe[14] The data collected from wildlife admissions by WRCs are increasingly used in scientific research.[12,18]

Spotlight on bat rehabilitation

Spurred by education and public relations efforts, an upswing in engaged citizens caring about the welfare of bats has emerged. When injured or distressed bats are found, people are better educated about how to help them—namely, bringing them to their local wildlife rehabilitation center. For example, in 2019 a total of 2,798 bats were admitted to WRCs in the United States and Canada, of which 40% were released.[14] Given that hundreds of similar facilities exist across the world, it is not unreasonable to assume that tens of thousands of bats are admitted to WRCs each year.

Once bats are admitted to these facilities, most centers rely on just three main information sources to determine best care practices. *Bats in Captivity* covers both Megachiroptera and Microchiroptera species, with a focus on bats staying in long-term captivity.[19] The "bible" of insectivorous bat care is authored by Amanda Lollar of Bat World Sanctuary. Their published care manual, *The Rehabilitation and Captive Care of Insectivorous Bats*, is the most thorough and detailed care guide for wildlife rehabilitators.[1] *Wild Mammal Babies: The First 48 Hours and Beyond* gives detailed instructions for infant care.[20] Along with presenter information (name, address where bat was obtained, hypothesized causes of admission), standard data collected upon initial intake during the physical exam includes species identification, weight, sex, age, and documentation of physical attributes, such as body condition, fractures or other injuries, and disease symptoms (R. Handy, personal observation).[14] Throughout the patient's time at the facility, daily records of treatments and observations may also be recorded. Most facilities also record the final disposition (released, held in long-term care, or euthanized) as well. With many WRCs encountering similar challenges treating and promoting recovery of individual bats, the development and sharing of effective practices with other WRCs and the research community provides opportunities for rapid advancement in knowledge.

Potential Opportunities

Bats are regularly listed as being among the most poorly known vertebrates. The World Conservation Union, for example, categorizes most bat species as Data Deficient and notes that more than half of bat species have no available data on population trends.[21] Because proactive approaches to conservation, which include gathering basic biological knowledge and documenting population trends and risk factors, are more effective than reactive strategies,[22] WRCs are well-positioned to contribute to bat conservation. The data collected from bats by WRCs during standard operations offer tremendous opportunities for research. In addition, having bats in hand provides unique opportunities to collect biological samples and to measure behavior difficult to observe in nature. The data collected by WRCs has the potential to reveal new or emerging threats from both anthropogenic and natural factors. The fact that many WRCs use digital databases as a source of record-keeping can facilitate rapid acquisition of information for researchers interested in collaborating with WRCs. Many rehabilitation centers in the U.S. use national databases which offer a way for wildlife health professionals to use their records. WILD-ONe, the Wildlife Incident Log/Database and Online Network created by the Wildlife Center of Virginia, is a free system WRCs can use for patient management and data management and analysis. Currently, at least 107 active organizations across five countries contribute data to this resource.[14] WILD-ONe provides conservation researchers a way to "obtain standardized incident data on injured and orphaned wildlife,"[14] offering opportunities to identify trends and characterize human impacts on bats that warrant attention.[12] Examples of observations that may be extracted from the database include pathogen occurrences,[23,24] domestic pet interactions,[10,18] window or building collisions, and vehicle strikes.[12] The consistency with which such information is included in patient records varies. To improve the value for research and improvement of best practices for bat care, we recommend the minimum information to record for each bat (Table 1). Adding details as to whether each type of information was confirmed or suspected will help researchers assess which subsets of data to include in their analyses.

TABLE 1. Recommended minimum information WRCs should record into WILD-ONe from admitted bats to improve the scientific value of the data collected and therefore the continued advancement of best care practices. For each value, "Confirmed" or "Suspected" should be added to improve data filtering by researchers. Relevant articles also include examples from other taxa that may be applied to Chiroptera.

	CRITICAL FACTORS	RELEVANT ARTICLES
ADMISSION	Species	(Long et al. 2020)[12]
	Rescue location	
	Date found	
	Circumstance of rescue (window collision, domestic pet interaction, etc.)	(Long et al. 2020, Demezas and Robinson 2021, Khayat et al. 2020)[12,18,65]
	Age/Sex/Weight	(Long et al. 2020, Demezas and Robinson 2021, Wund 2005)[12,18,38]
	Injury details	(Khayat et al. 2019)[65]
	White-nose syndrome status	(Turner et al. 2014)[27]
	Parasites (types, present vs. absent)	(Reeves et al. 2016, Graciolli et al. 2019)[66,67]
	Band or tag number, if applicable	(Norquay et al. 2013)[68]
CONCLUSION OF CARE	Disposition (i.e. end result of care; release, euthanasia, death, etc.)	(Long et al. 2020, Molina-López et al. 2013)[12,69]
	Date of disposition	(Molina-López et al. 2017)[70]
	Release location, if applicable	(Kelly et al. 2008, Ruffell et al. 2009)[40,71]

Collaboration/Partnerships

Stakeholders who may benefit from collaborating with WRCs include researchers and scientists, government agencies, policy-makers, students and teachers, and the public. Many stakeholders are interested in bat biology as well as the conservation issues they face. Because most conservation issues confronting bats, such as habitat loss, human disturbances, and climate change, are common across many organisms,[5,25] collaborations on studies of bats can have wide-reaching effects.[22,26]

Scientific researchers

Wildlife rehabilitation centers can contribute to scientific discovery (Table 2). When WRCs collect and place patient information into databases like WILD-ONe, they actively contribute to the potential for improving knowledge of bats. For instance, WILD-ONe is a nationwide database, so data deposited there can be used by researchers to detect and monitor wildlife health trends at large geographic scales. For example, Long et al. (2020)[12] reviewed 45,668 wildlife database records comprising over 280 wildlife species that were admitted to a WRC in Ohio over a 10-year time span. Their findings indicated the potential to learn about disease trends, human impacts at the local level, and what conservation topics would be most beneficial to emphasize in local outreach programs.[12] Expanding analyses from one center to many facilities across larger geographic areas could influence conservation efforts in many ways, such as promoting early detection of new diseases,[23,24,27] potentially quantifying occurrence of rabies and other known zoonotic diseases, characterizing widespread patterns of negative interactions with invasive species,[18,28] identification of periods of highest injury or mortality risk,[29,30] and identification of new injury or mortality sources as our environment changes.[31–33]

TABLE 2. Examples of potential research questions wildlife rehabilitation centers could help answer by collecting data in collaboration with academic researchers, science and management agencies and conservations groups. Decisions regarding involvement of particular bats should always be ethically considered.

QUESTION	POTENTIAL METHODS	MATERIALS NEEDED	RELEVANT ARTICLES
What are the most common injuries and sources of mortality for bats entering WRCs and how do they vary across landscapes?	Systematically search wildlife databases for circumstances of rescue.	Permission and access to WILD-ONe/other databases used by WRCs.	(Khayat et al. 2020, Long et al. 2020, Demezas and Robinson, 2021, Schenk and Souza 2014, Taylor-Brown et al. 2019, Duffy 2020)[11,12,18,72,73,74]
What are the physiological responses (e.g., cardiac activity, ventilation rate, body/tissue temperatures) bats exhibit during rehabilitation and/or artificial hibernation?	Use of biological sensors in the environment or attached to individuals in care; hormonal stress studies via blood samples or guano (ethically choosing which animals are suitable).	Biotelemetry and/or biologgers (sensor tags); fecal samples.	(Wilson et al. 2015, Kelm et al. 2016)[39,48]
What pesticides or other chemical toxins/pollutants are present in bats and do they vary by foraging strategy (i.e., insectivorous vs. nectivorous) or rescue location?	Depending on chemical of interest, various methods are available utilizing biomarkers to indicate pesticide and/or chemical levels.	Biological samples (i.e., fur, blood, guano, tissue).	(Bayat et al. 2014, Eng et al. 2019, Sandoval-Herrera et al. 2021, Wilcox et al. 2021)[47,75,76,77]
What emerging pathogen trends exist and how do they vary across geographic regions?	Various methods depending on pathogen of interest. Example, swabbing and using long wave UV light to detect the presence of white-nose syndrome.	Biological samples (i.e., fur, blood, guano, swabs).	(Randall et al. 2012, Camacho et al. 2016, Turner et al. 2014)[23,24,27]
How does development of echolocation behavior differ between orphaned, hand-reared bats, and wild post-natal bats?	Foraging test arena with trials of various amounts of "clutter" (i.e., open areas vs. artificial trees); see Wund 2005[38] for details.	Bioacoustics detector, recorder, and software, test arena, flying prey.	(Mukhida et al. 2004, Wund 2005)[37,38]
Do differing care and pre-release conditions (e.g., artificial hibernation, flight training, exposure to native prey) alter survival and behaviors of released bats?	Radio-tag bats prior to or upon being released from care to monitor behavior and track activities.	Radio-transmitters and telemetry equipment; artificial hibernation equipment (e.g., wine cooler protocol), native and/or flying prey, flight tent/arena.	(Serangeli et al. 2012, Kelly et al. 2008, 2012; McGuire et al. 2012, 2014; Jonasson and Guglielmo 2016, Krauel et al. 2018)[13,40,78–82]
What is the post-release survival rate of rehabilitated bats over the short- and long-term and how do those rates vary by species, injury type and geography?	Band bats prior to or upon being released from care. Would require follow-up mist-net surveys and band information entered into an accessible database.	Radio-transmitters and telemetry equipment, wild-caught individual(s) to act as a control; Bands or other permanent tagging options. High-speed video camera, software to analyze flight patterns.	(Serangeli et al. 2012, Kelly et al. 2008, 2012)[13,40,78]
What are the post-release behaviors of rehabilitated bats over the short- and long-term and how do these behaviors vary by species, age, injury type, pre-release conditioning protocols and release location?	Radio-tag bats prior to or upon being released from care and monitor for activity. Flight pattern study comparing healthy bats, bats with varying degrees of wing tears, and rehabilitated bats. Utilize software or could perform an observational study and create an ethogram of flight patterns. Radio-tag bats prior to or upon being released from care and track via MOTUS towers.	Radio-transmitters and telemetry equipment, wild-caught individual(s) to act as a control. Nanotags, MOTUS receiver.	(Serangeli et al. 2012, Kelly et al. 2008, 2012, Morningstar and Sandilands 2019, Bell et al. 2019, Monarchino et al. 2020, Clerc et al. 2021)[13,40,42,78,83–85]

Researchers can also benefit by gaining easier access to bats than might be possible under natural conditions, saving time and resources.[34,35] An example is the relatively new and growing trend at WRCs to house bats in wine coolers, which serve as less expensive versions of metabolic chambers. WRCs can mimic the winter environment bats seek during the hibernation portion of their annual life cycles, instead of keeping bats awake and active unnaturally (R. Handy, personal observation).[36] Maintaining bats appropriately in hibernation saves rehabilitation centers time and resources and also could provide researchers access to hibernating bats that might be difficult study in the wild. Consideration should be given by rehabilitation centers, however, for appropriateness of artificial hibernation, given suitable physiological conditions of bats. We encourage close monitoring by veterinary staff of all bats put in conditions that may induce torpor.[1] Furthermore, captive bats in suitable physical condition could be used in echolocation studies, such as Mukhida et al.'s[37] or Wund's[38] studies examining the echolocation calls of different species in spaces with different configurations of environmental clutter, thus revealing basic biological information about how bats navigate and interpret their environment. However, bats in a captive setting, such as a WRC, may not demonstrate the same behaviors exhibited in the wild, and this possibility should be considered carefully.

When bat patients have been deemed healthy and fit for release back to the wild, appropriately trained researchers can band or radio-tag them. Such studies could promote our understanding of the short- and long-term success of rehabilitation treatments by monitoring survival and distances moved after release. Radio-tracking technology is continuously improving with size reductions of technology and implementation of passive antenna arrays listening for radio signals.[39] Kelly et al.[40] used a 14-day tracking period to monitor post-release survival of bats. This was useful in learning about the survival rates of released rehabilitated bats. Serangeli et al.[13] studied the habitat preferences of released rehabilitated bats via radio-telemetry. To track movements over much larger areas, scientists are using nanotags in combination with MOTUS towers to track the paths of migratory birds, and, in some cases, in collaboration with WRCs (T. Jasinski, personal communication). Such movement tracking helps determine not only where birds are going (including important migration stopover habitats), but also window and building collisions that may ultimately impact formation and implementation of conservation policies.[34,41] The same opportunities exist to use this technology to track bats, especially for migratory species whose movement patterns are poorly understood. For example, the MOTUS tower tracking system was used to track a Hoary Bat (*Lasiurus cinereus*) over 827 km in Ontario.[42] Using this technology can help scientists better understand migratory species' behaviors, which are highly vulnerable to anthropogenic factors such as collisions and barotrauma from wind turbines.[6,43–45] We are unaware of any published studies in collaboration with WRCs regarding radio-telemetry or nanotag and MOTUS studies of migratory bats.

Finally, WRCs have no shortages of biological materials useful for learning about bats. Fur, fecal material, blood, and tissues are typically discarded but offer many opportunities to improve knowledge of bats and their interactions with the environment and other species. Stable isotopes from tissues help scientists understand the environmental toxins bats encounter.[22,46] Sandoval-Herrera et al.[47] documented toxicity levels in insectivorous bats from blood samples; Richards et al.[35] describe methods to apply environmental monitoring via fur and feather samples; and Kelm et al.[48] utilized fecal glucocorticoid metabolite concentrations to monitor stress hormones in bats non-invasively. Feces are increasingly used to assess dietary composition by identifying DNA barcodes via eDNA studies.[49,50] The research opportunities using samples from bat patients at WRCs are abundant.

Hoary bat (*Lasiurus cinereus*).

Education partners

By partnering with rehabilitation facilities, students at local universities can practice development and design of research projects. Many facilities regularly engage students as volunteers. In addition to training them to follow best practices for bat care, students learn the necessities for appropriate vaccinations and following safe handling protocols, and the complexities of daily work at WRCs. In turn, WRCs benefit from the availability of eager and enthusiastic assistance when staffing funds are in short

supply. Veterinary and veterinary technician students in particular make a great pairing, if WRCs have the time to invest in training these students.

Government agencies and policymakers

In the realm of wildlife rehabilitation, government agencies are typically responsible for regulating facilities via permitting, which can involve local, state, and federal levels. For example, Ohio rehabilitation facilities are required to obtain a permit to rehabilitate wildlife in the state, which is regulated by the Division of Wildlife within the Ohio Department of Natural Resources (ODNR).[51] Additionally, when federally endangered or state-sensitive bat species are presented, WRCs and rehabilitators are required to notify officials immediately so these rare species can be documented properly. Government agencies and other policymakers also assist with various wildlife protections, some of which may be influenced by what local non-governmental organizations (NGOs) and other conservation groups are doing. Bills like the Bird-Safe Buildings Act, H.R. 919, which helps both birds and bats,[52] are gaining public support as awareness grows.[41] For example, in 2019 after partnering with conservation groups such as the Ohio Bat Working Group, the Ohio government signed into law "National Bat Week" during the month of October.[53,54] When WRCs are on the front lines of this type of conservation, they have the opportunity to provide expert consultation directly to legislators,[34,55] especially given the large amount of data WRCs can provide about bats and their mortality sources. With collaboration between conservation groups and the support of our government leaders, public perception of bats and the importance of their conservation can improve.

TABLE 3. Recommendations for wildlife rehabilitators and their collaborators to advance bat biology and conservation.

WILDLIFE REHABILITATORS OR CENTERS	COLLABORATORS
1. Be open to opportunities to engage researchers and others in the mission of your rehabilitation center.	1. Be cognizant of the funding and staffing limitations most WRCs encounter and offer solutions when seeking collaborative opportunities.
2. Train personnel to accurately and completely enter data from bat admissions into databases such as WILD-ONe.	2. Proactively share new discoveries on bat behavior or health care needs from peer reviewed literature.
3. Seek collaborators who can help train personnel to gather and share accurate data.	3. Volunteer at your collaborating WRCs to care for the bats you are studying.
4. Encourage collaborators to volunteer at your center to improve their understanding of the challenges and constraints you face when caring for patients.	4. Get the appropriate animal care training and vaccinations completed prior to approaching WRCs with ideas for collaborations.
5. Ensure ethical practices are undertaken while providing bat care, especially when new methods or protocols are enacted.	5. Ensure bats are handled and studied ethically, keeping in mind that animal welfare is a main tenet of WRCs; utilize an ethics review process whenever possible.
	6. Follow through on commitments to make research or other information publicly available, giving appropriate credit to your WRC collaborators.

The Community

By offering the public opportunities to learn accurate information about bats and their biology, WRCs reach people through personal interactions (R. Handy personal observation),[56,57] educational programs,[12,31,58] and via activism and volunteerism.[34] WRCs can share information, trends, and protocols for care and handling of bats through formal and informal channels. As concerns for conservation of bats continue to grow, it seems to be increasingly important for WRCs to partner with other NGOs within their community, especially with those that share similar missions. WRCs typically have limited resources; therefore, collaborating with local NGOs allows for cooperation between organizations via shared data, advocacy,[57] public education, and even sharing of volunteers. Such cooperation can also improve development of best practice guidelines for bat care in WRCs across the nation.

As an example that WRCs might emulate, the Dubai Turtle Rehabilitation Project (DTRP) rehabilitates injured and ill sea turtles then releases them. Although their work has had positive effects on threatened turtle populations, they go a step further by satellite tracking released individuals and using that data to inform conservation efforts in the region.[33] Their data are uploaded to Movebank, a free, online database which assists animal tracking researchers by managing, sharing, analyzing, and archiving information.[59,60] As radio-tagging and tracking technologies continue to improve for use with bats, rehabilitators and fellow conservationists could follow in DTRP's footsteps to aid in various chiropteran conservation efforts.

Potential Pitfalls

When biodiversity data sources are freely and openly available, conservation efforts benefit.[61] Yet, the act of sharing data can present its own challenges. A lack of data collection method standardization can make using the data in reliable ways difficult. Furthermore, a lack of infrastructure within WRCs themselves can complicate their ability to share data.[12] This can be especially true when organizations utilize their own independent data platforms or still use paper instead of digital databases.[61]

While WRCs offer a wealth of bat data collected annually,[12] published articles based on WRC databases are still relatively rare.[62] Lack of standardization of databases, and variation in

data entry skills, can reduce data accuracy and uncertainty, discouraging researchers from using WRC data.[12,18,62,63] Even when accurately entered and curated, data may be incorrectly assessed at time of admission, being influenced by the reports provided by the rescuer.[62] Once admitted, bats pose challenges atypical of many other organisms. Determining the species and correct age of bats requires precise measurements such as forearm length and degree of bone ossification.[64] The limited number of trained staff and volunteers available at WRCs, let alone those who are rabies vaccinated, presents obstacles to accurate data collection. Furthermore, institutional resistance amongst organization leaders can hinder the progression of scientific integration, especially when the organization's existing framework lacks support.[22] Nevertheless, if these limitations can be addressed or even documented appropriately, researchers can recognize and handle such challenges during data analyses. We argue that the challenges are worth overcoming to promote the gain in useful knowledge of bat biology and conservation.

Summary

As human populations continue to grow, the number of bats getting injured or becoming ill due to anthropogenic reasons will likely also increase. Local and global bat conservation networks recognize risks faced by bats and strive to develop management plans, yet wildlife rehabilitation centers and their potential contributions are hardly considered.[25] Wildlife rehabilitation centers are well-positioned to be prominent voices in the chiropteran conservation conversation, despite intrinsic challenges they may face. Where possible, wildlife rehabilitation facilities can provide a valuable counterbalance to these threats by impacting the welfare of individual bats and potentially reducing severity of local population declines under certain conditions. On a broader scale, these centers can promote conservation by fostering relationships with other important stakeholders, such as researchers, scientists, academics, governing agencies, policymakers, and the community at large. To promote advancing knowledge of bat biology and conservation through opportunities presented by WRCs, we offer recommendations for WRCs and their collaborators (Table 3).

Wildlife rehabilitation centers can provide immense amounts of data and research opportunities to enhance chiropteran conservation. Improving and expanding partnerships between researchers and these facilities promises to further strengthen our knowledge of bats and the threats they face.

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Acknowledgments

The authors would like to offer their sincere thanks and gratitude to Susie Dunham and Bruce Dugger for their continued support and guidance throughout this project. We would also like to extend our appreciation to Ann Wookey and to the staff and volunteers at the Ohio Wildlife Center: your unrelenting dedication to wildlife and tireless hours of hard work does not go unnoticed. Thank you also to an anonymous reviewer for their time and constructive feedback on the manuscript.

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