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Using expert knowledge to identify key threats and conservation strategies for wildlife: A case study with bats in China

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ABSTRACT

Global biodiversity is in rapid decline, yet the key threats to wildlife in many regions remain uncertain. Bats are one of the most diverse mammalian groups, playing vital roles in the ecosystems. There are at least 140 bat species in China, with 30 % of being regionally threatened or data deficient. Here, we used expert elicitation to assess the key threats and conservation strategies of bats in China. We designed an online questionnaire concerning the conservation of Chinese bats, and then distributed the questionnaire to bat experts worldwide via email. All participants were asked to rank each threat and conservation strategy according to the urgency and significance. After excluding participants without some knowledge of Chinese bats and conservation biology, we gathered the opinions of 119 bat experts from China and abroad. The results showed that the scores of different threats and conservation strategies were predicted by their categories. Loss of habitat, killing and hunting, and roost disturbance were regarded as the three top threats faced by Chinese bats. Most experts recognized that banning hunting and improving the legislation were two priority strategies for bat conservation, although monitoring of bat diversity, scientific publicity, and education were also important. Nearly 98 % of the experts supported the suggestion that threatened bats should be under special state protection because of their ecological services, economic value, population decline, scientific value, and other features. These results provide valuable implications for guiding the protection and management of bats in China.

1. Introduction

Biodiversity is critical for maintaining ecosystem services upon which human beings rely (Cardinale et al., 2012; van der Plas,

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2019). However, the magnitude of human impacts on ecosystems has rapidly increased with the expansion of *Homo sapiens*, yielding a global crisis of biodiversity loss (Barlow et al., 2016; Newbold et al., 2016; Johnson et al., 2017). Evidence from the fossil record indicates that current extinction rates of vertebrates are nearly 100 times greater than the background levels, on a par with the "Big Five" mass extinction events that occurred during the past 540 million years (Barnosky et al., 2011). Despite increased conservation efforts in most countries, more than 9300 vertebrate species are still threatened by human-induced stressors according to the International Union for Conservation of Nature Red List (IUCN, 2022). Under these circumstances, identifying the main threats and formulating conservation strategies for wildlife are the keys to achieving biodiversity conservation.

Given the limited information on population dynamics, time-lagged responses of biological variables to environmental change, and complex interactions among multiple anthropogenic stressors, disentangling the major threats to wildlife are challenging (Metzger et al., 2009; Senzaki et al., 2020). Expert elicitation, a technique used for aggregation of researcher opinions on a given topic about which there is uncertainty, is an alternative method of addressing such questions (Martin et al., 2012; Morgan, 2014). The synthesized opinions from experts can provide substantive information for risk assessment and decision making, and thus help enhance wildlife conservation and management efforts (Rudd, 2011; Martin et al., 2012; Miličić et al., 2021). Indeed, the extinction risk for species in the IUCN Red List depends largely on expert judgments concerning their population density and geographic range size (IUCN, 2001). Expert elicitation has been used for ranking the major threats faced by some wild animals, ranging from insects (Miličić et al., 2021) and sea turtles (Donlan et al., 2010; Riskas et al., 2018) to Alpine birds (Chamberlain et al., 2016) and some mammals (Can et al., 2014; Frick et al., 2017; Friedenberg and Frick, 2021).

Bats are an ecologically and taxonomically diverse group, accounting for nearly 20 % of all extant mammals (Simmons and Cirranello, 2020). They are distributed throughout the world, except in the polar regions and some isolated islands (Luo et al., 2019; IUCN, 2022). Bats provide vital ecosystem services to humanity, including arthropod pest control, seed dispersal, pollination, and nutrient redistribution (Boyles et al., 2011; Kunz et al., 2011; Aziz et al., 2021; Taweesub et al., 2021). In Thailand, for example, the wrinkle-lipped free-tailed bats (*Chaerephon plicatus*) consume insect pests in rice crops, reducing the loss of rice production that amounts to more than 1.2 million dollars per year (Wanger et al., 2014). In the Paleotropics, bats from Pteropodidae disperse the seeds for 311 plant species in 75 families (Aziz et al., 2021). Pteropodid bats also function as pollinators of 21 plant species from eight families (Aziz et al., 2021). The cave-dwelling bats serve as an important nutrient supplier, since their guanos are the dominant energy resource for many invertebrates in cave ecosystems (Ferreira et al., 2000; de M. Bento et al., 2021). Moreover, some bats are advanced echolocators; they are exceptionally long-lived mammals relative to their body size, and they are natural reservoirs of diverse viruses, making them an excellent taxon for studies of sonar design (Carrer and Bruzzone, 2017), healthy aging (Foley et al., 2018), and disease defense (Irving et al., 2021).

Despite their ecological and scientific value, bats face multiple threats from habitat loss, hunting and killing, roost disturbance, environmental pollution, collisions with wind energy turbines, climate change, and biological invasions (Voigt and Kingston, 2016; Feng et al., 2020; Frick et al., 2020). In many countries, negative perception of the public toward bats is engendered by a misunderstanding of the relationship between the causative agent of zoonotic diseases (e.g., COVID-19) and viruses from bats, posing a new challenge for bat conservation (Zhao, 2020; Lu et al., 2021; Nanni et al., 2022). Most bats are sensitive to anthropogenic stressors owing to their low fecundity, dense aggregation, and high metabolic rates (Voigt and Kingston, 2016). A total of 1329 bat species have been registered by the International Union for Conservation of Nature, and 16 % of these are considered critically endangered, endangered, or vulnerable, and 18 % are data deficient (IUCN, 2022). However, to date, the key threats and conservation strategies of bats in many regions remain largely unclear.

The goal of this study was to disentangle the key threats and conservation strategies for bats in China using expert elicitation. China is one of the most bat-rich countries, harboring more than 140 species according to the most recently updated list (Wei et al., 2021). The current status of Chinese bats is concerning, with 30 % of bat species being assigned to threatened categories or being data deficient based on the Red List of China's Vertebrates (Jiang et al., 2016). Yet, none of the threatened species of bats are included in the updated List of Chinese State Key Protected Wild Animals (LCSKPWA; http://www.forestry.gov.cn/main/5461/20210205/122418860831352.html), a priority for developing schemes for protecting endangered and rare species in China. Zhang et al. (2009a,b) reported that bat populations in China have declined considerably in the past decades, presumably owing to cave exploitation for tourism, extensive pesticide use, replacement of old buildings used as bat shelters, and the consumption of bat meat. Luo et al. (2013) revealed that 200 underground roosts of bats in southern and northern China suffered from human disturbance as a result of recreational activities. Feijó et al. (2019) retrieved 594 published literature related to bats in China from 2000 to 2017, but only 10 publications focused on the conservation of Chinese bats in the face of cave exploitation, climate change, wind-farm effects. The data deficient and threatened species of Chinese bats have received the least attention in the last two decades (Feijó et al., 2019). These findings indicate that bat conservation is an urgent and neglected research topic in China. Using an online survey, we attempted to address the following three questions: (1) What are the perceived causes of bat population declines in China? (2) How to effectively protect Chinese bats? (3) Whether threatened bats should put on the LCSKPWA?

2. Materials and methods

2.1. Questionnaire design

During March and April 2020, we created a web-based questionnaire entitled "Bat conservation in China: major threats and coping strategies" using Questionnaire Star. The questionnaire was composed of four sections and addressed a total of 17 questions (https://www.wjx.cn/jq/66714439.aspx). In the first section, we introduced the purpose and requirements of the survey. All participants were

asked to anonymously answer the questions based on their personal judgements. The second section contained five questions concerning background information of participants, including nationality, sex, education level, study field, and experience in bat research. The third part focused on the following questions: (1) the extent to which participants are familiar with population dynamics and conservation status of Chinese bats; (2) the key factors causing bat population declines in China; (3) the strategies for protecting Chinese bats; (4) the opinion on assigning threatened bats as state key protected wild animals; and (5) the reasons for positive or negative opinions. The threats and conservation strategies for Chinese bats, which were identified by the IUCN (IUCN, 2022) and previous reviews (Feng, 2020; Jiang et al., 2020), were divided into nine categories (https://www.wjx.cn/jq/66714439.aspx). All participants were asked to rank each threat and conservation strategy according to their urgency and importance following previous researches (Donlan et al., 2010; Can et al., 2014; Miličić et al., 2021). To reduce potential subjective effects, we also allowed participants to add additional ideas not listed in the questionnaire. Finally, we gathered information on the diseases suffered by participants due to their close contact with bats; this topic is not presented in this study.

2.2. Survey of expert opinions

We restricted the population surveyed to domestic researchers who had research experience on Chinese bats. To enhance geographical coverage, we also distributed the questionnaire to the attendees of the 18th International Bat Research Conference in the Kingdom of Thailand via email. We conducted a search of bat experts in the Web of Science (https://www.webofscience.com/) and Chinese Scientific database (http://www.cnki.net/), using the key words bat, behavior, ecology, conservation, evolution, and virus in English or Mandarin. Online survey requests together with the link to our questionnaire (https://www.wjx.cn/jq/66714439.aspx) were sent to the corresponding authors identified from the search via email. We asked the authors to take the survey and pass the survey on to their colleagues. The survey was available on-line in English for three months.

2.3. Data analysis

A total of 1062 respondents from 82 countries participated in the survey (Fig. 1a; Table S1). To guarantee data quality, we performed data processing based upon three criteria: (1) respondents with less than 2-year experience in the field of bat research were not considered as bat expert; (2) respondents without some knowledge of Chinese bats and conservation biology were excluded; and (3) experts' additional ideas within the scope of answers given by us were ignored. Finally, we retained data from 119 domestic (N = 16; Fig. 1b) and foreign experts (N = 103; Fig. 1b) for analysis. We scored each threat and conservation strategy to quantify their urgency and importance based upon the orders ranked by experts (Miličić et al., 2021). For a ranking question with 10 options, an individual option was scored as 10 when ranked first, 1 when ranked last, and 0 if it was unanswered. Generalized linear mixed model with a negative binomial distribution (GLMM), together with post hoc pairwise comparisons, were applied to determine whether the scores of different threats and conservation strategies depended on their categories and background information of experts using the R lme4 package (Bates et al., 2015). Expert nationality was divided into either domestic or overseas according to their home countries. The scores of different threats and conservation strategies were assigned as the dependent variable. The categories of threats and conservation strategies, coupled with expert nationality, gender, education level, and study experience, were assigned as fixed variables. To control for potential leading effects, the order of each threat and conservation strategy in the raw questionnaire was assigned as the random variable (Donlan et al., 2010). There were no significant interactions of predictor variables based on likelihood ratio test. We chose the best-fitting GLMM according to Akaike' s information criterion corrected for small sample size using the package MuMIn (Barton, 2016). All statistical analyses were performed in R 3.6.1.

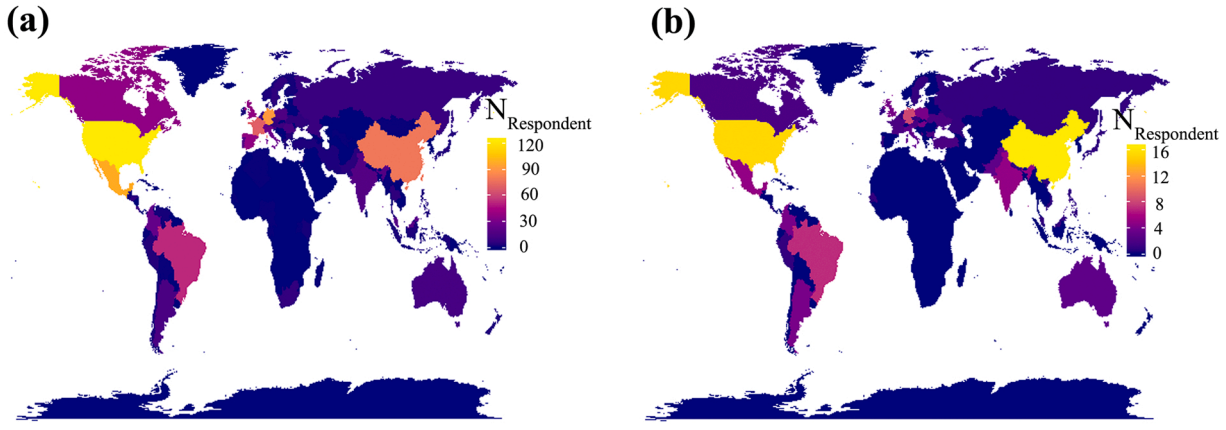

Fig. 1. Geographic distribution of respondents in this study. (a) All the respondents (N = 1062). (B) Respondents with some knowledge of Chinese bats and conservation biology (N = 119). $N_{Respondent}$: number of respondents.

3. Results

3.1. Major threats to bats in China

The nationality, gender, education level of experts was not retained in the best-fitting GLM for the urgency of different threats to Chinese bats (Table S2). However, the scores of different threats to Chinese bats were remarkably influenced by threat categories (GLMM: N = 119, estimate = −0.38, $z = -9.53$, $P < 0.0001$; Fig. 2) and experts' study experience (GLMM: N = 119, estimate = −0.11, z = −2.69, $P = 0.0072$). In general, habitat loss, killing and hunting, and roost disturbance were ranked as the first three threats, followed by chemical pollution, global climate change, light pollution, accidents caused by wind turbines and roads, biological invasion, and noise pollution (Fig. 2). In addition, three experts believed that diseases and public fear of bats were also responsible for bat population declines in China.

3.2. Conservation strategies of bats in China

Despite weak effects of experts' background information (Table S2), the scores of different conservation strategies were dependent on the categories (GLMM: N = 119, estimate = −0.24, $z = -4.54$, $P < 0.0001$; Fig. 3). Banning hunting of bats and improving the legislation were regarded as prioritized strategies for conservation of Chinese bats (Fig. 3). Moreover, developing a platform for monitoring bat species diversity, together with scientific publicity and education, were also important according to expert judgements. The average score of other conservation strategies was relatively low, including establishing nature reserves for bats, control of chemical pollution, roost monitoring and risk assessment, forest recovery, and installing bat boxes and constructing roosts at nature reserves (Fig. 3).

3.3. Threatened bats as state key protected wildlife

Nearly 98 % (117 of 119) of the experts recommended that threatened bats should be represented in the LCSKPWA (Fig. 4a). The major reasons behind the positive responses of experts were attributed to four aspects of bats, namely ecological services, economic value, population decline, and scientific value (Fig. 4b). Other factors were also responsible for the positive feedback of experts, including bats' cultural value, cute and friendly characteristics, vulnerability, the role of bioindicators in environmental monitoring, and the relevance to human health.

4. Discussion

Given the limited conservation resources and funding, identifying the major threats to wild animals is a prerequisite for implementing protection actions (Wilson et al., 2009; Carwardine et al., 2012). A least 140 bat species have been recorded in China, but one-third of these are threatened with extinction or are data deficient (Jiang et al., 2016; Wei et al., 2021). So far, the key threats and conservation strategies for Chinese bats are still uncertain and need further investigation.

Our survey of expert opinions indicated that habitat loss is the most serious threat faced by Chinese bats, a result that echoes previous summaries of global challenges to bat conservation (Mickleburgh et al., 2002; Frick et al., 2020). From a global perspective, anthropogenic activities such as deforestation, urbanization, and resource exploitation have caused considerable loss and fragmentation of natural habitat for many bats (Fenton et al., 1998; Lane et al., 2006; Haddad et al., 2015). It is estimated that the forest area of China has declined by 95,000,000 hm^2 (or 9.2 % of the coverage rate) during the last 300 years, albeit with a trend of recovery after the implementation of afforestation and forest protection programs (He et al., 2008; Liu et al., 2019). In China, the urban area increased

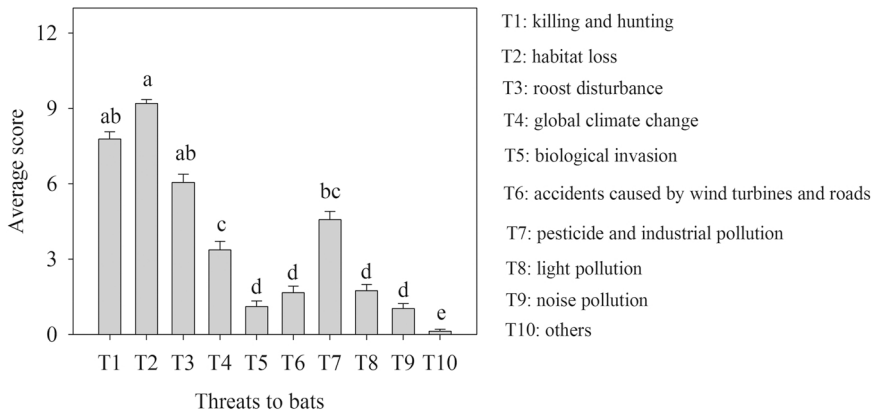

Fig. 2. The urgency of different threats to bats in China. Error bars represent standard error. Letters above bars identify the threats that significantly differ from each other in post-hoc pairwise comparisons (Table S3) based on the best-fitting generalized linear mixed model.

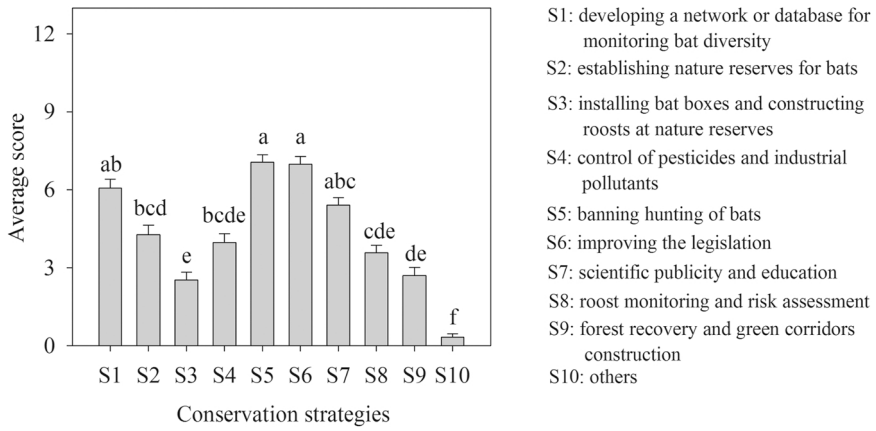

Fig. 3. The importance of different conservation strategies for Chinese bats. Error bars represent standard error. Letters above bars identify conservation strategies that significantly differ from each other in post-hoc pairwise comparisons (Table S4) based on the best-fitting generalized linear mixed model.

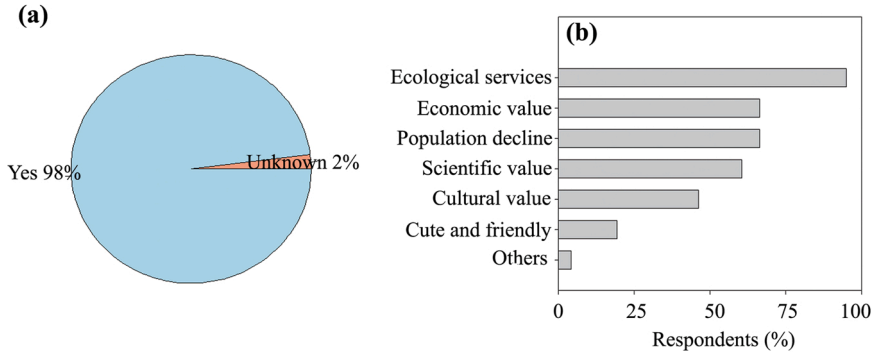

Fig. 4. Expert judgements on the presence of threatened bats in the List of Chinese State Key Protected Wild Animals. (a) Expert opinions. (b) Reasons for positive feedback.

from 2846 km^2 in 1990–43,199 km^2 in 2016, and the proportion of people living in urban areas increased from 6.6 % in 1990 to 56.74 % in 2016 (Ritchie and Roser, 2018). Loss of habitat is identified as the most common threat to Chinse bats according to IUCN assessments (IUCN, 2022). More specifically, 56 species of Chinese bats are threatened by habitat destruction due to residential and commercial development, expansion of agriculture and aquaculture, energy production and mining, logging, and ecosystem modifications (Table S5; IUCN, 2022). Detrimental effects of habitat destruction on bats have been validated in China and other regions. In the Wuling Mountains of central China, for example, foraging habitats of Chinese horseshoe bats (*Rhinolophus sinicus*) are fragmented by roads, residential land, and farmland, reducing their available space for food acquisition (Liang et al., 2018). In Thousand Island Lake of East China, species richness of forest-dependent bats increases with island size based upon passive acoustic monitoring, suggesting that these species are adversely affected by dam-induced forest fragmentation (López-Bosch et al., 2022). Similarly, forest fragmentation is a negative predictor of abundance and species richness of cavity/foliage-roosting bats in peninsular Malaysia (Struebig et al., 2008). In the Neotropics, dietary composition of Pallas's long-tongued bats (*Glossophaga soricina*) in banana plantations is more simplified than that of conspecifics foraging in forests (Alpízar et al., 2020); loss of roosts causes a decrease in social cohesion but an increase in home range size in leaf-roosting disc-winged bats (*Thyroptera tricolor*) (Chaverri and Kunz, 2011). Muylaert et al. (2016) found that bat species richness declined sharply when 47 % of primeval forests were lost, albeit the negative impacts of habitat loss on bats depend on foraging guilds. These findings confirm that the impacts of habitat loss on bats are not confined to populations but rather reach the community level as well.

Killing and hunting were ranked as the second greatest threat to Chinese bats by domestic and foreign experts. This is not surprising, given that 22 species of Chinese bats are threatened by hunting and trapping based on IUCN assessments (Table S5; IUCN, 2022). Several possible explanations may be responsible for this threat. First, exploitation of bats for bushmeat is widespread across Africa, Asia, Oceania, and Central and South America (Mickleburgh et al., 2009; Mildenstein et al., 2016). This was the case in southern China before the epidemic of severe acute respiratory syndromes (SARS). Although bat meat is not popular among most of the Chinese public, consumption of bats (i.e., *Eonycteris spelaea*, *Rousettus leschenaultia*, *Pteropus giganteus*, and *Hipposideros pomona*) has been previously reported in Guangdong, Guangxi, and Hainan Provinces (Mildenstein et al., 2016). Hunting bats for food is detrimental to a

population's survival and reproduction, and in some cases may even cause the extinction of local populations (Mildenstein et al., 2016). However, this phenomenon has rarely been found in China after the SARS outbreak, given that illegal hunting and trading of terrestrial wild animals including bats have been prohibited by the department of wildlife conservation (Chinese State Council, 2003). Second, the bodies and internal organs of bats may be exploited as major components of traditional medicines (e.g., bat powder), as shown in the database of traditional Chinese medicine (https://www.zhzyw.com/). Third, bats may be destroyed owing to their negative reputation stemming from fruit crop damage, use of human buildings as shelters, and carrying viruses that may be the origin of human pathogens (Mildenstein et al., 2016; Voigt et al., 2016; Zhao, 2020). The synanthropic bats are disliked by some residents because of their noisy vocalizations, the odor of their feces, and the risk of parasite transmission (Han, 2006). Some people expelled synanthropic bats from their houses and supported bat culling proposals after the breakout of COVID-19 owing to a misunderstanding of the link between bats and COVID-19 (Zhao, 2020; Lu et al., 2021). Accordingly, the negative reputation of bats perceived by most of the Chinese public has put them at high risk of being killed.

Roost disturbance was regarded as another key factor underlying the bat population decline in China. This is consistent with IUCN assessments, which show that 31 species of Chinese bats suffer from human disturbance (Table S5; IUCN, 2022). Roost disturbance is evident for bats inhabiting underground habitats owing to the intense pressures from tourism, limestone quarrying, and other human activities (Zhang et al., 2009a, 2009b; Luo et al., 2013; IUCN, 2022). Niu et al. (2007) found that seven underground roosts in Funiu Mountain harboring large populations of intermediate horseshoe bats (*Rhinolophus affinis*) have been transformed into tourist sites. Bu et al. (2015) assessed the level of human activities in 129 underground roosts inhabited by 32 bat species in southern China, suggesting that 45 underground roosts were under serious threats imposed by tourism exploitation. Some myotis bats dwelling in karst caves in Hunan Province experience disturbance from folk ceremonial ritual activities (Wu et al., 2018). Luo et al. (2013) surveyed 225 underground roosts occupied by 57 bat species across southern and northern China, and the results indicated that almost 90 % of bat roosts suffered from human disturbance due to recreation. The flow of humans in underground habitats can cause an accumulation of CO_2 and a rise in ambient temperature, inducing a shift in preferred microclimatic conditions for bats (Song et al., 2000). Noise resulting from human recreation can be disturbing to hibernating bats, leading to the bats' stored energy being wasted and making it difficult for them to survive in cold winters (Thomas et al., 1990; Thomas, 1995). Moreover, limestone quarrying can destroy the physical structure and topography of caves, forcing cave-dwelling bats away from their shelters (Whitten, 2009; Furey and Racey, 2016). Development of subterranean roosts for tourism and industry purposes also involves the introduction of human visitation, roads, car parks, and artificial lighting (Furey and Racey, 2016), which in turn accelerate human impacts in and around subterranean habitats. Given the rich bat diversity (~115 species) and the generality of human disturbance in subterranean habitats in China, protection of underground roosts and their surrounding areas should be a high priority for bat conservation.

Our government has revised the policies to improve the conservation of wildlife in recent years (Chinese State Council, 2005, 2014, 2016). The transgressors will be sentenced to less than three years in prison if they illegally hunt terrestrial wild animals in the sanctuaries during non-hunting seasons, even for those species that are not included in the LCSKPWA (Chinese State Council, 2016). Illegal hunting of common terrestrial wildlife outside the sanctuary will be fined by imposing a penalty that corresponds to a five-fold value of captured animals, depending on the level of damage (Chinese State Council, 2016). The responsible parties must conduct habitat restoration if they destroy core habitats of common terrestrial wildlife in the sanctuary, along with a penalty that corresponds to a two-fold cost of habitat restoration (Chinese State Council, 2016). China's National People's Congress also adopted the legislation banning the consumption of field-harvested or captive-bred wildlife after the COVID-19 outbreak (Yang et al., 2020). These policies provide legislative protection for bats in China. However, two important conservation measures that are recommended by bat experts are still ignored, namely monitoring the dynamics of bat diversity and scientific publicity or education. These measures can be achieved through enhanced cooperation among bat researchers, department of wildlife conservation and management, and local volunteers, as suggested by bat conservation practices in Europe and North America (Barlow et al., 2015; Kingston et al., 2016).

Should threatened bats be included in the LCSKPWA? Considering bats' ecological value, economic value, population decline, scientific value, and other aspects, most domestic and foreign bat experts supported this proposal. Even though the revised wildlife conservation legislation can be effectively implemented (Yang et al., 2020), the absence of threatened bats in the LCSKPWA still exposes them to risk. Besides killing and roost disturbance imposed by some residents, bats in China also suffer from other pressures such as habitat loss, environmental pollution, and climate change (Voigt and Kingston, 2016). The cumulative effect of multiple stressors could further accelerate population declines in bats, especially for insectivorous species that forage in agricultural and forest landscapes (Frick et al., 2020). These threats faced by bats are beyond the reach of wildlife protection policies in China. One recent study highlighted the importance of endangerment, endemism, rareness, preciousness, and management criteria in identifying China's key protected species (Jiang et al., 2019). In this case, the king horseshoe bat (*Rhinolophus rex*) is an ideal candidate due to its globally endangered status, endemism in China, and rare population (Sun et al., 2020). *R. rex* only occurs in seven provinces of southern China, including Guizhou, Sichuan, Chongqing, Guangdong, Guangxi, Hunan, and Yunnan (Zhang et al., 2009a, 2009b; Luo et al., 2013, 2017; Wu et al., 2018). The estimated population size of *R. rex* ranges from 1500 to 2000, which is less than that of giant pandas (*Ailuropoda melanoleuc*a) under the first class protection (State Forestry Administration, 2015; Sun et al., 2020). *R. rex* also coexists with other bats, rodents, and invertebrates in caves, and thus can serve as a flagship species in underground ecosystems (Luo et al., 2013, 2017). Therefore, we recommend that the department of wildlife conservation and assessment experts put *R. rex* in the LCSKPWA, at least in the near future.

5. Conclusions and conservation implications

We used expert elicitation to assess the key threats and conservation strategies for Chinese bats, two generally neglected aspects of

bat conservation in China. Our survey of expert opinions highlights that habitat loss, killing, and roost disturbance are the three top threats to Chinese bats. Despite the improved legislative protection for Chinese bats, more efforts are needed to strengthen the publicity and enforcement of wildlife protection law. Two additional strategies targeting the conservation of Chinese bats also deserve to be explored, namely monitoring the dynamics of bat diversity and environmental education. We recommend that subterranean roosts and surrounding habitats should be a high priority for bat conservation in China, especially for those harboring threatened bats and rich bat species diversity. The tourism, limestone quarrying, and other anthropogenic activities in underground roosts and surrounding habitats exploited by bats should be assessed by conservation biologists prior to their initiation. To maintain daily activities of bats dwelling in underground sites, mitigation measures need to be tailored to each stressor caused by recreation, resource exploitation, and other anthropogenic activities. Given bats' valuable ecosystem services and population decline, the majority of experts advocated improving the current protection level of threatened bats in China. We believe that *R. rex* is an ideal choice for a state key protected wild animal, since this species has satisfied three basic criteria (i.e., endangerment, endemism, and rareness) under special state protection. An addition of *R. rex* to the list of wildlife under special state protection could significantly alter public perception of bats, thereby providing a foundation for the development of bat conservation in China. One possible concern is that the results of our survey may be affected by sample size. Nonetheless, we still found similar results after excluding respondents without deep knowledge of Chinese bats and conservation biology (Fig. S1-S3; Table S6-S7).

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

The raw data supporting the study is presented in the supplementary material.

Acknowledgements

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Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.gecco.2022.e02364.

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