Local perceptions of biodiversity loss and conservation: Insights from rural communities around a key protected area in Hainan, China

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DECLARATION OF AUTHORSHIP

I hereby declare that this thesis is composed entirely my own original work. This thesis has not been previously published elsewhere. Where I have consulted the work of others, this is always referenced appropriately. Contributions made by others in the form of data collection, analysis, and financial support are indicated clearly.

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Date: 15th March 2021

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ABSTRACT

Understanding human dimensions of biodiversity loss is a fundamental component of conservation science and is essential to implementing effective and appropriate conservation measures. Engaging with people living near protected areas is especially important because these communities are often highly resource-dependent yet live alongside biodiversity and habitats that are highly threatened. However, baseline knowledge of local perceptions about human-environment interactions are often lacking in conservation projects. This thesis contributes to the science-based conservation work of the Zoological Society of London's Hainan Gibbon Project by addressing specific knowledge gaps, focusing on the perspectives of local people. Key research questions investigated patterns in perceptions of wildlife decline, ecological knowledge, and attitudes towards conservation management, while exploring the sociodemographic variations in perceptions. Research was carried out by conducting interview surveys in rural villages around key protected areas in Hainan, China. Findings indicate that peoples' reported forest use, reasons for non-use, and preferences for access to resources was highly variable between the protected area they lived near, suggesting that case studies are valuable for providing site-specific insights but that generalizing conclusions across a landscape is difficult. While local people expressed good understanding of local wildlife decline and extirpations, the acceptance of extinction being possible and the understanding of extinction as a scientific concept were lower. Extinctions were mainly attributed to local human activities, and governmental authorities were seen to be the most responsible for conservation. Ecological knowledge of native species threatened by unsustainable trade varied greatly among interviewees, although greater knowledge was not associated with the relative market value of the species. Limited recognition of endangered species may be problematic for reducing hunting and trading pressures. The medium of conservation outreach activities tended to leave more of an impression on the local audiences rather than the substance of the messages communicated. The Hainan gibbon, the focus of local conservation work, was highly salient among interviewees, and awareness of the gibbon was positively related to reporting of past outreach activities and suggest that such activities are nonetheless important. Various individual sociodemographic characteristics were associated with different perceptions, highlighting the importance of considering fine scale contextual patterns of human dimensions in conservation. Findings reaffirm the value of using local perspectives to inform conservation decisions and provide actionable management recommendations that encourages the co-existence of local people and biodiversity.

LIST OF FIGURES AND TABLES

Chapter 6

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Co-author contributions

Except for portions noted below, I undertook all other work in each chapter.

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OTHER RELEVANT PUBLICATIONS DURING PH.D. STUDY

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Dufourq., E., Durbach, I., Hansford, James. P., Hoepfner, A., **Ma, H.**, Bryant, Jessica V., Stender, Christina S., Li, Wenyong, Liu Zhiwei, Chen, Qing, Zhou, Zhaoli, and Turvey, S. T. (2021). Automated detection of Hainan gibbon calls for passive acoustic monitoring. *Remote Sensing in Ecology and Conservation*, early view. https://doi:10.1002/rse2.201

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CHAPTER 1

INTRODUCTION

1. HUMAN DIMENSIONS KEY TO CONSERVATION

The framing of conservation in research, policy, and public domains has evolved considerably over the past six decades, and now focuses on 'People and nature', in contrast to the earlier framings of 'Nature for itself', 'Nature despite people' and 'Nature for people' (Mace, 2014). Human dimensions are increasingly recognized as fundamental to conservation because stopping biodiversity loss and species extinction depends on changing human-nature interactions at the individual, community, and societal levels (Bennett et al., 2017; Ceballos et al., 2015; Schultz, 2011; Sutherland et al., 2009). There is high spatial overlap between biodiversity hotspots and areas of high human presence, especially in developing regions in the world and concentrated in the tropics (Brooks et al., 2006; Fisher & Christopher, 2007; Myers et al., 2000). Despite conservation prioritization, anthropogenic threats to biodiversity are especially acute in these areas, which also tend have the least resources for conservation (Brooks et al., 2006; Myers et al., 2000). Although the world's population is rapidly urbanizing, 44% remain rural in 2019, with a higher proportion in low income and less developed countries (World Bank, 2021). These populations, often also agricultural-based and impoverished, are more directly reliant on ecosystem services and natural resources for their livelihoods (Millennium Ecosystem Assessment, 2005).

While there are no fixed definitions, the Convention on Biological Diversity refer to local communities as groups of people that have close association with the lands that they have lived on and used, rely on local resources, have specialist knowledge of their environment, and may include indigenous peoples and traditional societies (CBD, 2004). In developing regions, such communities may live in close proximity to intact ecosystems or protected areas and engage in activities negatively impacting local biodiversity, such as hunting, deforestation, natural resource extraction, and conversion of natural habitats for agricultural production (Adams et al., 2004). At the same time, many indigenous communities have developed sustainable environmental management practices that support biodiversity and ecosystem resilience (Gadgil et al., 2011). The proactive engagement with these communities, through collaboration in research, involvement in decision making, and sharing of benefits, is thus vitally important to achieving conservation goals (Berkes, 2004; Gómez-Baggethun et al., 2013; Sutherland et al., 2017).

To effectively incorporate the multifaced relationship between local communities and biodiversity into conservation, applied interdisciplinary research is needed to understand the determinants and processes regulating human-nature interactions (Bennett et al., 2017; Moon et al., 2016). Over the last two decades, conservation management has become increasingly evidence-based, which advocates for decision-making to be grounded in the best-available data (Sutherland et al., 2004). At the local level, complex social and political dynamics drive interactions between people and the environment and underpin the successes and failures of conservation (Amano et al., 2018; Brooks et al., 2012; Nilsson et al., 2016). However, context-specific evidence is often lacking or inaccessible to practitioners in areas of conservation priority, impeding the application of appropriate conservation measures (Christie et al., 2020). For example, studies testing the effectiveness of conservation interventions are heavily concentrated in North America, Europe, and Australia and tend to be published in English, while evidence from non-English speaking but biologically diverse regions tend to be underrepresented in the conservation science literature (Christie et al., 2020).

Indeed, evidence on the human dimensions of conservation is challenging to gather due to the sheer diversity of social, cultural, and political conditions within and between societies. Moreover, the development of the 'People and nature' framing of conservation was both encouraged by and enhanced the roles of historically marginalized people being more formally recognized by governing bodies and incorporated into international conservation frameworks, i.e. IPBES and CBD Aichi Target 18 (CBD, 2004; Mace et al., 2014; Diaz et al., 2015). Conservation science could therefore be further strengthened by including more research on human-nature relationships to complement existing evidence in the biological, ecological, and economic dimensions (Bennett et al., 2017). To address this issue, research targeting specific gaps in current understanding of how local communities view and interact with the environment is required.

2. LOCAL PERCEPTIONS AS A FORM OF CONSERVATION EVIDENCE

Humans experience and respond to their surroundings in complex ways, one of which is through perceptions of a situation or a thing. Perception is a 'quick, acute, and intuitive cognition', or 'a mental image or concept', and to perceive means 'to attain awareness or understanding of something' (Merriam-Webster, n.d.). In the context of conservation social science, perceptions represent ways in which an individual interprets and evaluates something based on a combination of his or her experience, knowledge, values, motivations, and other contextual factors such as

personal attributes and social and cultural norms (Bennett, 2016). Often, knowledge refers to 'the fact or condition of being aware of something or knowing something with familiarity gained through experience or association' (Merriam-Webster, n.d.). Similarly, awareness, or 'the knowledge and understanding that something is happening or exists' (Merriam-Webster, n.d.), is used interchangeably with knowledge in this thesis, because the term concerns knowing of a species' existence or comprehension of environmental change. This is also because in conservation, awareness raising activities typically aim to increase understanding of species and conservation issues by introducing new knowledge to the audience with the intention of changing their attitudes and ultimately their behaviors. In comparison, an attitude is a 'feeling or emotion toward, or a mental position with regards to a fact or state' (Merriam-Webster, n.d.), and has a role in impacting behaviors, for example as postulated in the Theory of Change (Biggs et al., 2017). Knowledge, awareness, and attitudes, among other factors influencing perceptions, are interdependent and often influence each other, and interactions between them have been studied to better understand decision-making in conservation management in response to ecological crisis (Biggs et al., 2011). In this thesis, the concept of perceptions is used in consistence with Bennett's (2016) explanation, which acknowledges the ambiguity in the usage of the term but also outlines the relationships between the various factors that contribute to forming an individual's perceptions within the environmental and conservation science literature. The term 'knowledge' is applied to the ecological knowledge that communities living around a key protected area possess about wildlife and the immediate environment around them.

Within the scope and limitations of my research, I focus on understanding the patterns of local community perceptions and the correlations between perceptions and with several other factors including knowledge and attitudes, rather than the underlying mechanisms driving interactions or establishing causality between these factors. This is because in there is often a lack of basic understanding of such perceptions in data-poor contexts, so obtaining a baseline is usually the first step to further engagement with the system. This thesis thus builds on the foundations of Bennett (2016) and Pyhälä's (2016) arguments that local perceptions of the environment make valuable contributions to conservation.

Local perceptions of the environment, which reflect individual and community knowledge, awareness, and attitudes, constitute an important type of conservation evidence, but have been overlooked in the existing body of knowledge (Bennett, 2016; Pyhälä et al., 2016). This bias in both scholarship and in conservation management agendas is partly due to unbalanced power dynamics in the history of conservation (Sandbrook, 2017). For example, the colonial roots of

natural history and protected areas have led to the voices of certain groups of more powerful people being favored over those of the less powerful (Brockington and Igoe, 2006; Das and Lowe, 2018). Therefore, for conservation to be more inclusive and fair, the incorporation of other ways of perceiving and knowing the environment into research and practice is needed.

Encouragingly, perceptions of local communities have been increasingly studied to address numerous conservation challenges, including human-wildlife conflict (Alexander et al., 2015; Campbell-Smith et al., 2010), attitudes towards wildlife (Arbieu et al., 2019; Vincenot et al., 2015), protected area governance (Hirschnitz-Garbers & Stoll-Kleemann, 2011; Karanth & Nepal, 2012; Nuno et al., 2021; Thondhlana & Cundill, 2017), impacts on livelihoods (Bennett & Dearden, 2014; Harvey et al., 2018), and wildlife consumption and trade (Liu et al., 2011; Raymundo & Caballes, 2016; Turvey et al., 2021). Local perceptions about ecological phenomena, such as extinction and species decline, are also important for understanding varying world views rooted in cultural traditions (Forth, 2016; Wehi et al., 2018). Especially insightful are perceptions about relationships, such as those between people and wildlife, and between local communities and reserve management authorities, because they reveal important dynamics that affect conservation outcomes.

While local perceptions can provide multidimensional insights on human-nature interactions, such views may not be consistent within and between communities (Agrawal & Gibson, 1999; King et al., 2018; Pyhälä et al., 2016). Importantly, it should not be taken for granted that people of diverse social and cultural backgrounds have the same uniform understandings of conservation concepts as formally trained scientists or professionals. For example, research has shown that understanding of species extinctions varies greatly between cultures (Heise & Heise, 2010; Sodikoff, 2011), and even coexisting communities may have different perceptions of species decline and its drivers (Camino et al., 2016; de Azevedo et al., 2012; Vallejo-Betancur et al., 2018). The lack of consensus on key concepts, values, and interpretations due to varying perceptions could then render some conservation interventions controversial (Jørgensen, 2015; Nogués-bravo et al., 2016). Attention to these differences in local perceptions can help capture the heterogeneity of local conditions, contributing to more useful evidence bases for conservation decision making.

Despite the direct relevance to conservation, literature on local perceptions of the environment point to knowledge gaps and opportunities for progress. Research on local perceptions is geographically biased towards Africa and North and Central America and demonstrates a need for more work addressing the diversity in perceptions to make comparisons between contexts

(Pyhälä et al., 2016). With limited understanding of local perceptions and their patterns and nuances, conservation decision making is then hindered by the lack of context-specific evidence, constrained by poor understanding of local conditions (Christie et al., 2020). For conservation to be more inclusive and participatory, incorporating the perceptions, especially of local communities that are both impacting and impacted by conservation, is therefore fundamental to achieving a more pluralistic approach to environmental protection (Berkes, 2007).

At both the individual and collective level, perceptions are partially shaped by knowledge (Bennett, 2016; Pyhälä et al., 2016). Ecological knowledge, or the understanding of the environment gained through one's own experiences or learned from others, plays an important role in human-nature relationships (Berkes et al., 2000; Gadgil et al., 2011). It is derived from a combination of experiences, observations, and beliefs that explain the complex natural world (Berkes et al., 2000; Gadgil et al., 2011). The terms local and traditional ecological knowledge are frequently used interchangeably. Although traditional ecological knowledge differs from local ecological knowledge in that traditional knowledge is accumulated within a community and passed down through generations (Huntington, 2000), they are both developed and held by people who live in close relationship with the natural environment, and can be adapted in response to environmental change or crisis (Folke et al., 2005). When interpreted alongside other factors that influence perceptions, such as attitudes, awareness, and values (Bennett, 2016), ecological knowledge can be especially valuable to conservation because it can provide nuanced understandings of complex conservation issues.

Given its versatile nature, the importance of ecological knowledge has been increasingly recognized in conservation research and practice (Aswani et al., 2018). Ecological knowledge can contribute data on extremely rare and threatened species in the form of local peoples' sighting and hunting experiences, complimenting data from traditional ecological surveys (Pan et al., 2016; Turvey et al., 2014; Turvey et al., 2015). Specifically, ecological knowledge of the direct users of biodiversity, such as that of hunters and fishers, can provide vital information on the threats and patterns of biodiversity loss in addition to species distributions and ecology (Butler et al., 2012; Hancock et al., 2017; Lin et al., 2019; Pham et al., 2020). In the absence of long-term ecological surveys, local perceptions of wildlife populations are particularly valuable in providing vital information necessary for conservation decision making (Turvey et al., 2017). Importantly, as one of the Convention on Biological Diversity's (CBD) Aichi Targets (Target 18) (CBD 2010), integrating ecological knowledge into conservation validates the views of local and

indigenous communities and contributes to the more inclusive governance of biodiversity (Berkes, 2007).

Substantial effort has been dedicated to studying the patterns of variation in ecological knowledge, such as with demographic and sociocultural characteristics (Aswani et al., 2018). For example, elderly people tend to have more knowledge of environmental conditions in the past (Beaudreau & Levin, 2014; Turvey et al., 2010), and varying differences in knowledge between genders may be due to differences in societal roles (Nyhus et al., 2003). Knowledge is also influenced by social factors such as schooling, migration, and kinship relationships (Nyhus et al., 2003; Reyes-García et al., 2010; Salpeteur et al., 2015). However, there is still limited research on the patterns of ecological knowledge relating to specific conservation issues, such as knowledge of species extinction, decline, and knowledge of anthropogenic threats such as wildlife trade. Targeting these gaps would make insights gained from ecological knowledge and other perceptual data more directly applicable to addressing conservation challenges.

3. USING PERCEPTIONS TO INFORM CONSERVATION PRACTICE

When applied to conservation practice, interventions can be made more specific, appropriate, and effective with the integration of local perceptions (Bennett, 2016). Perceptions, including those derived from ecological knowledge, can contribute to improving numerous conservation activities that involve local communities, including conservation outreach effectiveness, protected area management, and understanding and mitigating species decline. For example, perceptions of local communities towards endangered lemurs and their habitat can inform protected area management strategies, such as determining whether zonation, alternative livelihoods, and educational outreach may be accepted and feasible (Reibelt et al., 2017; Waeber et al., 2018).

It is important to recognize that having certain perceptions alone does not determine behavior change (Schultz, 2011; St John et al., 2010). For example, poaching can be primarily motivated by economic incentives, rather than negative attitudes caused by conflicts with wildlife (Liu et al., 2011). Neither do perceptions always represent objective truths since many factors influencing perceptions, such as social norms and values, are subjective. Different stakeholder groups may have contrasting views about protected area management policies affecting resource access, allocation of benefits, and relocation of villages, or relationships between authorities and local people (Bennett et al., 2019; Hirschnitz-Garbers et al., 2011; Thondhlana & Cundill, 2017; Xu et al., 2006).

Nonetheless, perceptions have direct implications for conservation activities because they represent reality to the people holding these views (Bennett, 2016). In the case of marine protected area management, Bennett et al., (2019) demonstrated that perceptions of good governance and social outcomes, while they cannot always be objectively measured, were positively correlated to support for protected areas. Failing to account for these views could then lead to conflict that can undermine conservation goals (Hirschnitz-Garbers et al., 2011).

Investigating how different aspects of local perceptions affect each other, such as relationships between ecological knowledge, conservation outreach, and attitudes towards wildlife, have direct practical implications for shaping conservation practice. For example, reviews of conservation outreach strategies, including education, social marketing, and campaign messaging, found that effectiveness of these activities is seldom evaluated (Green et al., 2019; Kidd et al., 2019; Thomas et al., 2019). In cases in which they are, evaluation usually focuses on whether conservation outreach succeeded in changing knowledge and attitudes, such as increasing enthusiasm for wildlife, or behavioral outcomes such as reducing the killing of protected species (Rakotomamonjy et al., 2015; van der Ploeg et al., 2011). In contrast, limited work exists that explores the perceptual factors underpinning outreach effectiveness, such as how ecological knowledge and retaining campaign information influence each other (Howe et al., 2012). Likewise, the mixed effects of celebrity endorsement in awareness raising exemplifies the need to better understand how audience perceptions of the means of communication affects the outcome (Duthie et al., 2017; Jeffreys, 2016). Similarly, studies involving local community perceptions about protected area management often concern associated impacts, benefits, conflicts, and alternatives (Anaya & Espirito-Santo, 2018; Bennett & Dearden, 2014; Karanth & Nepal, 2012; Oldekop et al., 2016), while few explicitly investigate the underlying patterns and potential drivers of variation of these perceptions, such as the impacts of governance, resource dependence, and freedom of choice on feelings of personal empowerment (Nuno et al., 2021).

Research on wildlife consumption and trade provides more descriptive evidence on the extent and drivers of trade (Bush et al., 2014; Esmail et al., 2020; Marshall et al., 2020; Nijman, 2010), but studies examining how the behaviors of various actors in trade are influenced by their perceptions, such as social norms around consumption and preferences for keeping rare species as pets, are limited (Ribeiro et al., 2019; Veríssimo et al., 2019). Furthermore, context-specific dimensions of perceptions, such as cultural norms, are also often overlooked, resulting in missed opportunities and slow progress in mitigating threats to wildlife, as exemplified by the difficulty in reducing the demand for wildlife consumption in China where there are deeply entrenched

values and established institutions that promote such use (Thomas-Walters et al., 2020; Zhu & Zhu, 2020). Filling these gaps in understanding of the drivers that may influence local perceptions therefore can have direct and immediate impact on management decisions.

4. CHINA'S CONSERVATION CHALLENGES

China is a biologically megadiverse country with high species richness and endemism (Jiang., 2016; Liu et al., 2003; Myers et al., 2000). It contains more than 30,000 species of vascular plants and nearly 3,000 species of vertebrates, comprising more than 10% of the world's total respectively; over 20% of these vertebrates are endemics (Jiang., 2016; Liu et al., 2003). Furthermore, China is socio-culturally diversity, including 55 ethnic minority groups which often have unique languages and religious belief systems. This diversity underpins different environmental management practices and outcomes, many of which are rooted in cultural and spiritual traditions (Coggins, 2003; Gu et al., 2012; Gu, 2019; Salick et al., 2007; Urgenson et al., 2010). As anywhere else, throughout China's nearly five millennia of human history, people have depended on natural resources for food, medicine, raw materials, and cultural and spiritual purposes. Demand for agricultural land and urban development has driven large scale transformation of the environment, including deforestation in all but the mountainous southwest where access is difficult, and alteration of wetlands in the fertile Yangtze and Yellow River valleys to expand urban centers (Elvin, 2004; Lander & Brunson, 2018). With high human populations exerting intense pressure on the environment, wildlife extinctions occurred alongside human development and population growth (Coggins, 2003; Marks, 2017; Turvey et al., 2007).

Since the 20th century and throughout the 21st century, China's natural ecosystems and the biodiversity that they support have been under extreme threat from human pressures (Liu and Diamond, 2005; Marks, 2017; Shapiro, 2001). More recently, China's increasing wealth as it rises to the world's second largest economy is demanding even more land, energy, and resources both domestically and beyond its borders (Li & Shapiro, 2020). The Living Planet Report- China estimated that over the last four decades, 50% of China's terrestrial vertebrate populations have declined, mainly attributed to habitat loss, hunting, and climate change (WWF, 2015). Furthermore, 21% of China's vertebrate species are threatened with extinction, higher than the global average (Jiang, 2016). Despite rapid urbanization, 40% of China's population is rural as of 2019; among these, some of the country's poorest communities live in remote areas near remaining fragile natural ecosystems (World Bank 2021; Wang et al 2020). In many cases,

coexistence between local communities and wildlife is challenging. For instance, human-wildlife conflicts persist and negatively impact rural livelihoods when large mammals damage crops and predate on livestock (Alexander et al., 2015; Chen et al., 2013; Liu et al., 2011).

Research on human-wildlife dynamics, including the anthropogenic drivers and patterns of past extinctions has been limited. Evidence on the human pressures on threatened species, and how important aspects of conservation are perceived by relevant communities, is mostly patchy due to the lack of long-term biological and social data (Ma et al., 2017). As a result, endeavors to save highly charismatic endangered species such as the Hainan gibbon have been constrained by the lack of robust evidence (Turvey et al., 2015). Considering the complexity of environmental challenges in China, the interplay between human activities and wildlife conservation is therefore a priority research area for improving evidence. While conservation science research in and on China is growing rapidly, more comprehensive and targeted study of human-nature relationships at the community level is needed to better engage stakeholders, including local communities, in conservation (Liu et al., 2016; Mi et al., 2021). Therefore, China is an ideal study system for exploring local peoples' ecological knowledge, understandings of conservation concepts and issues, and responses to interventions such as public outreach and reserve management to improve conservation. The following sections further discuss the gaps and opportunities in these topics and highlight the importance of incorporating local perceptions in conservation within the Chinese context.

4.1 Protected areas

Biodiversity conservation in China has primarily relied on the establishment of protected areas, and more recently, national parks (Ma et al., 2019; W. Xu et al., 2019; Zhang et al., 2017). Improved understanding of local peoples' use and attitudes towards protected area policies, and how they vary across spatial and temporal scales, would provide more practical support for the management of China's protected areas. Between 1956 and 2018, China established 2,750 protected areas, covering a total of 1,470 thousand square kilometers, or 15% of China's land area (National Forestry and Grassland Administration 2020).

However, the effectiveness of reserves at achieving conservation targets is debated. With low law enforcement, protected areas can be ineffective at preventing poaching and habitat degradation (Gong et al., 2017; Liu et al., 2001). Specifically, China's protected areas have been criticized for the lack of resources and management capacity, have competing priorities between conservation

and profit generation, and little consideration for local people who are excluded from access and use of resources (Wang et al., 2012; Xu et al., 2019). For example, where local communities live inside and around protected areas, household income was found to have decreased due to the loss of cropland to conservation areas, while income inequality was exacerbated by ecotourism (Ma et al., 2019).

Specifically, Xu et al.'s (2006) study of the perceptions of local communities outside Wolong Biosphere Reserve, a key protected area for giant pandas, revealed sources of conflict, varying knowledge, and context-specific patterns directly relevant to protected area management. Despite the importance of such dynamics, the diverse ecological and sociocultural contexts across China makes comparisons across sites challenging, and our knowledge is restricted to few case studies at the local scale. As a result, the human dimensions of protected areas in China are largely unexplored.

4.2 Understanding of wildlife extinction

China has experienced high levels of anthropogenic wildlife extinction throughout history (Elvin, 2004; Lander & Brunson, 2018; Turvey et al., 2019). However, there is little research on how people view wildlife decline and extinction at the local level, which is the scale at which most on-the-ground conservation activities operate and seek to make impact by mitigating negative human impacts. Recognition of local species disappearances has been noted in historical records in China, such as local gazetteer records (*difangzhi*), showing spatial and temporal patterns of species range contraction and collapse (Turvey et al., 2015). However, the first acknowledgement of extinction in scholarly work occurred in the late 19th century in China, coincidentally around the same time as in Europe (Marks, 2007). But in contrast to the studies of fossils by western naturalists, the idea sprung from observations of the relationships between species and the land, including the severe loss of natural forests (Marks, 2007).

More recently, local perceptions and knowledge of species extinctions are increasingly used to contribute information on rare and elusive species impacted by human activities (Lin et al., 2019; Nash et al., 2016; Pan et al., 2016). At the same time, there is also growing recognition of the importance of indigenous cultures, beliefs, and values in conservation, reflected by research that embraces pluralistic views about wildlife (Shen & Tan, 2012; Urgenson et al., 2010; Zhang et al., 2020). Interestingly, in China's grassroots environmental movement, the concept of extinction has also been applied to raise awareness of disappearing indigenous cultures, linking threats to biological diversity with that of cultural diversity (Hathaway, 2011).

There is therefore tremendous value in investigating the extent to which local people of different cultural and socioeconomic backgrounds understand key concepts such as extinction, since it should not be assumed that such understandings are uniform or aligned with scientific definitions. Specifically, determining whether local people comprehend that the extinction of wildlife is possible, but also how they perceive of the causes of extinction and decline would provide crucial information needed to inform science-based conservation.

4.3 Wildlife consumption and trade

The use of wildlife in China for subsistence and commercial purposes has been widely prevalent over millennia and remains deeply rooted in cultural traditions (Zhang et al., 2008; Zhu & Zhu, 2020). However, China's economic growth, resulting in increased wealth and purchasing power, has led to unsustainable demand for wildlife as luxury commodities for food, wellness, and pets in recent decades (Esmail et al., 2020; Zhang et al., 2008; Zhang & Yin, 2014). To mitigate these impacts, effective management of both legal and illegal wildlife trade depends on reducing uncertainties and increasing evidence, including systematic understanding of all actors in the trade network (Challender et al., 2015; t'sas-Rolfes et al., 2019).

Because motivations for trade are diverse and trading activity is often decentralized and widespread, local perceptions about trade are especially important. Local ecological knowledge gathered from communities that interact with species targeted by trade contribute valuable information to understanding the scope, scale, and distribution of threats (Gaillard et al., 2017; Nash et al., 2016; Turvey et al., 2021; Wang et al., 2021). For example, local ecological knowledge of pangolin hunting in recent history in Hainan showed there was relatively low hunting pressure until the promotion of state-led and nation-wide pangolin trade beginning in the 1960s, which then likely resulted in population collapse three decades later (Wang et al., 2021).

Additionally, public surveys, including that of consumers and traders, have provided insight into the factors driving trade and potential solutions to mitigate demand (WildAid 2014, Shi et al., 2020; Wang et al., 2020). More recently, in response to the COVID-19 pandemic that emerged in early 2020, wildlife trade has become central to the conservation discourse in and about China, with increased emphasis on the need to understand public awareness and attitudes (Koh et al., 2021; Shi et al., 2020; Zhu & Zhu, 2020). In many cases where trade originates from communities and where animals are harvested from the wild by local people, understanding how

local knowledge and experiences with wildlife relate to patterns of trade is of vital importance for conservation management.

4.4 Conservation outreach

As China continues to undergo rapid environmental change, evaluating the effectiveness of public outreach activities is critically important to inform conservation strategies overall. Yet understanding of conservation among the public is overall limited. While research on other aspects of environmental awareness and awareness raising campaigns have been conducted, such as water conservation, pollution, and overall environmental concern (Sun et al., 2018; Wong, 2003; Xu et al., 2013), studies specifically addressing the awareness of wildlife conservation issues are less common (Shi et al., 2020; Walther & White, 2018; Wu et al., 2020).

For example, research on birdwatching found that increased awareness among the public was associated with personally having positive experiences from nature based-leisure activities (Walther & White, 2018). Birdwatchers, typically educated, urban, and young people, expressed their concerns for biodiversity loss (Walther & White, 2018). However, the lack of awareness of many key threats driving the decline of wildlife in China is problematic (Zhang & Yin, 2014). Indeed, practitioners and consumers of traditional Chinese medicine were found to be largely unaware of the illegal trade in pangolin products, despite the pangolins being the globally most trafficked mammal and the existence of a sophisticated and extensive black market (Wang et al., 2020).

To reduce behaviors harmful to threatened species and in response to existing shortfalls in awareness in China, conservation awareness raising is increasingly used. Exemplified by recent large scale public campaigns enlisting celebrities aiming to reduce demand for wildlife, their effectiveness is nonetheless debated (Jeffreys, 2016). Occasionally, campaigns led by international conservation organizations have been criticized as culturally insensitive (Margulies et al., 2019). These problems reflect the overall lack of understanding of conservation within the Chinese cultural context and hinders the implementation of specific and appropriate outreach activities.

Furthermore, existing studies have been biased in the demographic groups they target for surveying, comprising mostly of university students, tourists, and urban residents (Shi et al., 2020; Walther & White, 2018; Wong, 2003; Xu et al., 2013). In contrast, evidence on how local

people living alongside biodiversity, especially rural, traditional, and indigenous communities respond to conservation outreach is lacking in China despite the importance of such communities in conservation.

5. HAINAN, A CONSERVATION PRIORITY

This thesis was developed from the long-term engagement of the Zoological Society of London's Hainan gibbon project, which aims to use evidence-based and interdisciplinary approaches to conserve the world's rarest ape, the Hainan gibbon (*Nomascus hainanus*). Hainan's natural tropical forests, now only found in protected areas, are some of the last remaining of its kind in China and contain high levels of species diversity and endemism, making them priorities for scientific research and conservation (Ouyang 2001). Hainan's recent history saw rapid economic development, posing severe anthropogenic pressures on its ecosystems, natural resources, and biodiversity, yet human interactions with the environment, specifically those of rural local communities living alongside Hainan's biodiversity, have not been well studied (Falkenheim, 2009; Turvey et al., 2015). Specifically, local perceptions about key conservation issues would greatly inform conservation activities but are currently lacking.

This chapter has described the value of local perceptions in conservation science and practice and set up a framework for the various components and related factors that impact perceptions, mainly focusing on knowledge, awareness, and attitudes. It also identified existing gaps in knowledge that constrain the effective inclusion of local communities and their environmental perceptions into conservation management. Based on the existing body of work, opportunities for further development, and the specific needs to advance understanding of this subject in China, this thesis uses Hainan as a study site to explore questions of global conservation relevance.

6. KEY QUESTIONS AND THESIS OVERVIEW

This remaining chapters in this thesis are organized as follows, with a set of key specific questions each addressed Chapters 3-6.

Chapter 2 provides background information on the study site on Hainan Island, including its biological and human components, and provides context of current conservation challenges and key questions investigated. A discussion of the methodological approach taken to answer these questions is also included.

Chapter 3 investigates whether and how local people's reported access and resource use varies around different protected areas across a landscape, and how site-specific these patterns are. The sociodemographic factors associated with reported forest use and non-use, changes in frequency of access, and wish for access are explored. Together, these questions evaluate the merits and limitations of case studies focusing on single protected areas and the local communities around them.

Chapter 4 assesses local perceptions of wildlife decline in rural communities, focusing on the understandings of wildlife extirpations and extinction, including whether local people consider extinction to be possible, and how such perceptions relate to perceived drivers of species loss and responsibility for conservation. Related aspects, including attitudes towards local resource use, and who is perceived to have responsibility for conservation, are also investigated.

Chapter 5 examines local ecological knowledge of traded species, focusing on whether local people have better awareness of species that are more valuable in the trade. This question is addressed by exploring how different indices of species awareness (salience, recognition from photographs, knowing the name, and perceiving the species to be traded) varies, and whether they correlate to the relative market values of the species.

Chapter 6 focuses on whether the message or medium is more impactful in conservation outreach activities by assessing whether the message or medium of communication was reported more by the target audience. Additionally, it investigates the relationship between salience of threatened species and awareness- whether knowledge of conservation outreach activities is related to awareness of threatened species.

Chapter 7 discusses the broader implications of the findings presented in Chapters 3-6 by situating local patterns against regional and international contexts, and provides recommendations for conservation and questions for further research.

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CHAPTER 2

STUDY SITE AND METHODS

1. Study site

1.1 Hainan's biodiversity

Hainan Island (108°36'43'' – 111°2'31'' E and 18°10'04'' – 20°9'40'' N, **Figure 2.1**) is the main land mass of Hainan Province, China, with an area of approximately 34,000 km². It is one of the most biologically diverse areas in China and a global conservation priority, forming part of the Indo-Burma biodiversity hotspot (Myers et al., 2000; Zhang & Ma, 2008). Hainan's climate is tropical and monsoonal, with an annual average temperature between 18-28 degrees Celsius and annual rainfall averaging 1,500-2,500 millimeters (The People's Government of Hainan Province, 2020). Mountains rise in the southwestern interior of the island, with the highest peak Mount Wuzhi reaching 1,867 meters; hills and alluvial plains form a ring around the mountains extending to the coast (The People's Government of Hainan Province, 2020). The combination of a moist tropical climate and varying topography give rise to tropical forest, grassland, mangrove, and marine ecosystems (Ouyang., 2001). Forests are concentrated in the center of the island, and include lowland rain forests, mountainous rain forests, tropical coniferous forests, monsoonal rain forest and evergreen forests (Ouyang., 2001). A total of 4,600 plant and 660 vertebrate animal species are found in Hainan, including 490 and 23 endemic species, respectively (The People's Government of Hainan Province, 2020).

Hainan's modern-day fauna includes many threatened species such as the Hainan gibbon (*Nomascus hainanus*), Eld's deer (*Rucervus eldii*), Chinese pangolin (*Manis pentadactyla*), and ten freshwater and terrestrial turtle species (The People's Government of Hainan Province, 2020). Most notably, Bawangling National Nature Reserve (BNNR) in western Hainan contains the sole population of the world's rarest ape, the Hainan gibbon (*Nomascus hainanus*), whose global population numbers around 30 individuals restricted to about 15 square kilometers. Once widespread across Hainan Island, the population was estimated to be about 2,000 individuals by the 1950s and underwent a dramatic decline until the 1980s, with as few as possibly seven individuals surviving only in BNNR (Chan et al., 2005). While the population has been stable and two new groups have formed over the last five years, the species remains critically endangered and vulnerable to threats that are amplified in small populations (Bryant et al., 2016; Chan et al.,

2020). BNNR is the primary focus of the research carried out in this thesis, but data collected from six other protected areas are also included.

Despite Hainan's high biodiversity, little baseline data exist for most species and areas of conservation interest. Rapid assessments have been conducted over the last two decades in Hainan's protected areas (Fellowes et al., 2001; Kadoorie Farm and Botanic Garden, 2020), and regional assessments of wildlife statuses provide additional information on many Hainan species (Lau et al., 2010). Additionally, taxon-specific expertise has led to valuable research on freshwater turtles (Gaillard et al., 2017a; Gong et al., 2006; Shi, 2006), marine cetaceans (Lin et al., 2019; Liu et al., 2017), galliformes birds such as the Hainan peacock pheasant (*Polyplectron katsumatae*) and Hainan partridge (*Arborophila ardens*) (Liang & Zhang, 2011; Rao et al., 2017), and ungulates, Eld's deer (*Cervus eldi hainanus*) (Zeng et al., 2005). Nonetheless, there is a lack of continuous long-term biodiversity monitoring using standardized methods, and as a result primary data is spatially and temporally fragmented for much of Hainan's enigmatic wildlife.

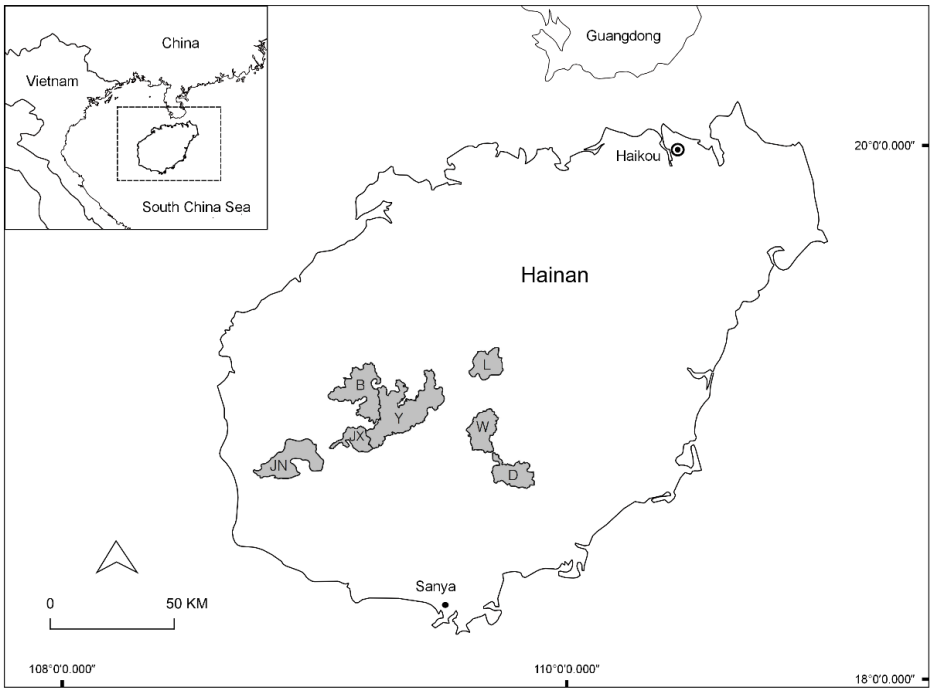

Figure 2.1. Location of Hainan Island and the protected areas where data for this thesis were collected from. B = Bawangling NNR; D = Diaoluoshan National Nature Reserve (NNR); JN = Jianfengling NNR; JX = Jiaxi Provincial Nature Reserve (PNR), L = Limushan PNR; W = Wuzhishan NNR; and Y = Yinggeling NNR.

1.2 Human dimensions

Hainan's current human population of approximately 8.7 million people consist of 83% Han ethnicity, with 17% of ethnic minorities peoples (Li, Miao, and Hui people) who differ culturally and linguistically from the dominant Han Chinese (National Bureau of Statistics, 2021). In particular, the Li are the only true indigenous peoples of Hainan, and as the largest minority group comprise of about 15% of Hainan's total population (Lian, 2003). Li and Miao people have relied on traditional livelihoods for millennia, largely based on swidden agriculture and hunting-gathering (Gu, 2019; Schafer, 1970). Animals are salient in the folklore and cosmologies of Li and Miao cultures (Gu, 2019; Netting, 1997), but the extent to which they influence modern day environmental management is unknown.

Hainan's recent history is closely associated with increasing human impact and exploitation of its natural resources. Prior to its formal incorporation into the Chinese empire in the first century BC, Hainan was largely independently governed by indigenous Li people. Throughout the history of imperial China (221 BC - 1912 AD), it was on the periphery of the empire and seen as an undeveloped backwater where political exiles were sent away to. In the 16th and 17th centuries, waves of migration from Fujian and Guangdong Provinces brought large influxes of Han people to Hainan, subsequently pushing indigenous populations to settle further in the central mountainous regions. The decades long Republic of China (1912-1945) and a brief period of Japanese occupation (1939-1945) saw increased extraction of Hainan's natural resources such as rubber and iron ore (Falkenheim, 2009).

Until the late 20th century, Hainan's economy has been primarily based on agricultural production and the supply of raw materials, exporting tropical fruits, hardwood trees, minerals, salt, and rubber to the mainland (Falkenheim, 2009). At the beginning of the People's Republic of China in 1949, Hainan was administratively part of Guangdong Province. However, it became an independent province and China's newest in 1988. At the same time, designation as a special economic zone, which led to rapid modernization and economic growth in Hainan. Tourism, mainly catering to domestic Chinese, began in the late 1990s and grew rapidly in the past two decades (Xie, 2001). While many popular destinations are nature-based, ethnic minority folk villages are frequently marketed as exotic attractions (Xie, 2001). Hainan's development over the last three decades can be characterized as a transitional economy and has experienced rapid urbanization and volatile markets (Gu & Wall, 2007). However, human development remains low in Hainan relative to other provinces in China, with high poverty and low education rates especially prevalent among its rural population (Gu & Wall, 2007). Many of the Li and Miao

communities surrounding protected areas are among the poorest in Hainan and in China, with many receiving subsidies from the government for poverty alleviation (Xie, 2001; Davies & Gu & Wall, 2007; Wismer, 2013). Meanwhile, infrastructure is rapidly being developed across Hainan, such as highway and high-speed railway networks. It is against Hainan's background of accelerating change and development that conservation operates and seeks to strike balances between people and nature.

1.3 Ecological degradation

Hainan's natural ecosystems have been deteriorating over the past several decades (Ouyang, 2001). Total forest coverage in Hainan has undergone dramatic changes over the past century, decreasing to as little as 15% in the 1970s, then increasing to 62% by 2020 (National Forest and Grassland Administration, 2020). However, reforestation has mainly been with non-native species in monoculture stands, which are less effective at supporting natural ecosystems, watershed health, and native biodiversity (Zhai et al., 2015). In fact, natural forest coverage has also contracted in area both inside protected areas and outside in buffer zones, attributed to the expansion of rubber and paper pulp plantations (Yu et al., 2016). Forest degradation has been severe, including that of habitats inside protected areas, and undermines the effectiveness of Hainan's reserves (Wu et al., 2011).

Human pressures on natural ecosystems have been intense and widespread in Hainan. Furthermore, widespread exploitation of diverse species of mammals, birds, and turtles pose serious threats to already vulnerable wildlife populations, and poaching and illegal wildlife trade occur across the island including from within protected areas (Melick et al., 2007; Lau et al., 2010; Liang et al., 2013; Nash et al., 2016; Gong et al., 2017). A combination of hunting and deforestation between the 1970s and 2000s was likely the main drivers for the decline of Hainan gibbons (Chan et al., 2005). While the Hainan gibbon population is now stable, other native wildlife species continue to be affected negatively by human activities. Exploitation of wildlife species in Hainan appears to be prevalent, including the widespread and intensive capture and trade of turtles (**Figure 2.2**; Wan et al., 2015, Gaillard et al., 2017), Chinese pangolins (Wang et al., 2021), and of birds (Liang et al., 2013, Xu et al., 2017; Wang et al., 2021).

Figure 2.2. A four-eyed turtle (*Sacalia quadriocellata*) (left) and a golden coin turtle (*Cuora trifasciata*) (right) shown by wildlife traders during a scoping trip. The four-eyed turtle is listed as Endangered on the IUCN Red List; the golden coin turtle is Critically Endangered.

Although several previous conservation action planning workshops focusing on key species have identified local human activities around protected areas as threats to biodiversity (Chan et al., 2005; Turvey et al., 2015; Wong et al. 2018), the magnitude of such pressures are still not well understood, and subsequently limits the proactive engagement with local communities in conservation decision making. Sustainable development and alternative livelihoods initiatives have had limited effectiveness on reducing poverty and dependence on forest-derived natural resources (Davies & Wismer, 2013; Gu, 2019). Revenues from tourism, a major sector of Hainan's economy, also have not contributed significant socioeconomic benefits to the local communities (Stone & Wall, 2004). Unfortunately, along with biodiversity loss, cultural traditions are also rapidly eroded among Hainan's indigenous Li communities. For example, folklore about gibbons is rapidly disappearing, and with this loss of traditional knowledge it is feared that the younger generations will be further detached from the environment in which their communities are rooted (Turvey et al., 2018). The local experience of communities living around Hainan's protected areas is therefore at the crossroads of human and ecosystem wellbeing, and must be an integral component in conservation planning.

1.4 Protected areas and local people

Conservation in Hainan has heavily relied on the creation and maintenance of protected areas. There are a total of 59 terrestrial protected areas covering 8.4 % of Hainan's land area (Chan et

al., 2005; Ministry of Ecology and Environment, 2013; Turvey et al., 2015; Wu et al., 2011). Of these, 7 are national level, 18 provincial level, and 34 are city and county level protected areas. The importance of protected areas for Hainan's conservation is significant. For example, as the sole habitat of the Hainan gibbon, BNNR in particular has been the focus of conservation research and attention both domestically and internationally. Local people have been impacted by a logging ban imposed in 1994, a hunting ban and confiscation of guns around 2000, and are prohibited from entering the core zone of the reserve and from harvesting natural resources (The People's Government of Hainan, 2014). Around BNNR and other protected areas, local people I encountered often spoke of the lower prices for cash crops and the lack of labor force, resulting in many giving up rubber and sugar cane production (**Figure 2.3**). Despite being directly affected by protected area regulations in the past, local people' perceptions towards environmental management and conservation policies are unclear.

Figure 2.3 A typical village setting outside Bawangling National Nature Reserve, Hainan.

In January 2020, Hainan Tropical Rainforest National Park was established, encompassing BNNR and five other national nature reserves and two provincial level reserves with the aim of conserving Hainan's overall biodiversity and remaining primary forest ecosystems (Zong, 2020). National park development is expected to bring new infrastructure development and relocation of

some villages (Chan et al., 2020). Simultaneously, Hainan National Park Research Institute was formed to centrally govern the management, research, and conservation action planning, involving interdisciplinary academics from various institutions and universities in China in the process (National forest and grasslands administration 2020). As more ambitious conservation plans are made for Hainan's protected areas, understanding local perceptions is all the more important.

2. Involvement in ZSL's Hainan gibbon project and work in China

This thesis builds on the long-term research and conservation activities of the Zoological Society of London's (ZSL) Hainan Gibbon Project (www.zsl.org/hainangibbon). ZSL has been involved in Hainan gibbon conservation since 2013, contributing to ecological research, conservation action planning, capacity building, outreach, and management recommendations. The research and conservation activities of the wider project are designed based on the best available scientific knowledge and aim to contribute new empirical evidence where most needed. Overall, conservation in the Bawangling socio-ecological system is constrained by the lack of long-term baseline data on its biological, ecological, and social components; low capacity and high turnover of local research and management personnel; and the need to adapt to rapidly changing provincial and national level conservation policies. Research questions addressed in this thesis specifically target key data gaps identified in our project's previous work, and consensus gathered from the wider international gibbon conservation community, overseen and supported by the IUCN Primates Section on Small Apes (IUCN SSA, https://gibbons.asia).

Since January 2016, I have been the project coordinator of the Hainan Gibbon Project, which involves carrying out and producing research outputs, fundraising, and reporting, overseeing undergraduate and master's student projects, management of equipment and data, engaging with stakeholders, networking with existing and potential partners, and planning logistics for field work and travel. Working bilingually, I also translated technical documents such as the Best Practice Guidelines for Gibbon Translocation and Rehabilitation (abridged version) into Chinese (Campbell and Cheyne, 2017), facilitated international workshops and co-produced reports, including the Hainan Gibbon Emergency Response Plan Meeting in 2016 and the Workshop on Conservation and Management of Chinese gibbons in 2018 (Chen et al., 2019).

The Hainan Gibbon Project aims to build an interdisciplinary and comprehensive evidence base for the Hainan gibbon and the BNNR system, with recent attention given to the expansion of

baseline knowledge of the human dimensions of conservation. This thesis, focusing on local communities' perceptions, complements numerous ongoing research endeavors, which have resulted in my co-authorship of the subsequent outputs (Dufourq et al., 2021; Liu et al., 2020; Qian et al., 2021). Additional and separate data gathered in the same interview survey for Chapter 6 evaluated the levels of awareness of the Hainan gibbon and its conservation status, and what sources local people receive information from (Qian et al., 2021). Results show that billboards were effective at disseminating information about several aspects of Hainan gibbon awareness, including its characteristics, population status, and the purpose of BNNR, but overall awareness was low and the effectiveness of educational programs could be improved to increase emphasis on the threats to conservation and the purpose of BNNR. Additionally, using remote sensing imagery and gibbon sighting records, we are currently investigating the limitations of gibbon distribution and the dispersal of new groups, e.g. the fragmentation of natural old growth forest. Following the formation of a new family group and its expansion into the village area outside the core zone of the reserve (Chan et al., 2020), the current research in the Hainan Gibbon Project aim to provide scientific basis for optimizing forest restoration. In addition to ecological constraints, we are evaluating the disturbance of anthropogenic activities and infrastructure on wildlife, which would lead to recommendations for national park management policies that balances development and conservation. By answering these questions, we hope to provide a more holistic picture of the BNNR conservation landscape.

Beyond BNNR, work on the Hainan Gibbon Project has fostered a conservation network of Chinese and international collaborators in Hainan during my employment. These collaborations have inspired additional research projects using interview survey to gather evidence on other understudied species (peacock pheasant, Eld's deer, Hainan gymnure, marine cetaceans), and comparative studies of human-gibbon relationships between in China and Vietnam. Additionally, the project activities strive to build capacity building for reserve management and students at local universities and promote the cultural heritage of local indigenous groups.

Throughout the five years of project coordination and Ph.D. research, I have also been involved, to varying degrees, in ZSL's wider conservation research in China on the Yangtze finless porpoise (*Neophocaena asiaeorientalis ssp. asiaeorientalis*), the Chinese giant salamander (*Andrias davidianus*), pangolin demand and illegal wildlife trade, and the Yangtze alligator (*Alligator sinensis*). My experience in coordinating project work and engagement with the academic, governmental, non-governmental sectors relevant to conservation provided valuable contextual understanding central to this thesis. Specifically, the evidence-based approach taken

by ZSL's long term projects in China inspired me to investigate the human dimensions of conservation challenges.

Overall, my experience in BNNR, in Hainan, and elsewhere in China provided substantial qualitative information and background knowledge on which I have developed my research questions and methodological approach. Insights gained from my engagement with a wide range of conservation challenges in Hainan and China motivated further inquiry into the perceptions, knowledge, awareness, and attitudes of local people towards biodiversity conservation, and inspired interest in the specific research questions addressed in this thesis.

3. Methodological approach

The field of conservation biology has its roots in the natural sciences since its establishment in the 1980s and further development in the 1990s (Soulé, 1985). However, only recently has it been widely acknowledged that natural science data and methods are insufficient in addressing the global crisis of biodiversity loss because the drivers are inextricably linked to human activities (Mascia et al., 2003). Furthermore, the newer framing of conservation as an endeavor for both 'people and nature' has propelled research to respond with novel approaches (Mace, 2014).

To tackle conservation involving the human dimensions, social science methods are now more proactively used in conservation research (Bennett et al., 2017). Interdisciplinary approaches drawing from the social sciences such as psychology, human geography, environmental history, and anthropology have not only generated tremendous insights for conservation, but also offer methodological contributions (Moon et al., 2019). Indeed, both research *for* conservation, to solve pressing conservation dilemmas, and *on* conservation, to study the movement itself, rely on the integration of social science methods (Sandbrook et al., 2013). In particular, research for conservation is driven by the practical goal of understanding conservation success and failures on the ground, and typically operates at the interface of people and nature, such as in communities surrounding protected areas (Sandbrook et al., 2013).

Despite these advances, numerous barriers remain conducting and communication conservation social science research (Fox et al., 2006). Often, the lack of interdisciplinary training for many researchers who only have natural science backgrounds prevents the use of social science methods in problem solving (Fox et al., 2006). Additionally, epistemological differences between the natural and social sciences also result in contrasting philosophical approaches and

assumptions of the researchers (Moon et al., 2019). Nonetheless, conservation social scientists seeking to understand the environmental issues through the lenses of diverse communities can benefit from embracing different world views and the co-production of knowledge by both researchers and research participants (Sutherland et al., 2017).

A wide range of tools for collecting data on the human dimensions are available, greatly aiding the integration of the social sciences in conservation (Newing, 2011). Interview surveys are among the most common ways of gathering information when working with people, because they are highly versatile and can be adapted to suit a wide range of questions and social contexts (Newing, 2011). Various interview methods can generate data on numerous social aspects of conservation issues and be tailored to specific needs of the research question and research context. Conducting surveys through interviews are cost-effective methods that can fill in data gaps where traditional biological and ecological surveys may fall short. Moreover, interview surveys can be used to understand the anthropogenic factors that affect conservation by directly gathering primary evidence from the groups of people most relevant to the issue or research question.

Specifically, interview surveys using standardized questionnaires allow for replicable and comparable data to be gathered across space and time, either by individual or teams of researchers. They are flexible, targeted, and efficient, and allow for comparisons between sites and over time, which increases replicability. For example, questionnaires can be administered to a large number of people over a vast area, such as across the distributional range of a species, and uncover spatial patterns in local perceptions (Turvey et al., 2010, 2021). Furthermore, a mix of closed and open-ended questions in a single questionnaire can collect both qualitative and quantitative data simultaneously. Additionally, close-ended questions can minimize ambiguity in the responses. These attributes are particularly advantageous in conservation systems with limited financial and human capacity to carry out research.

Questionnaire-based interview surveys, as with any research method, has limitations. Being aware of such limitations ensures sound interpretation of results, and ultimately, better transferal of research findings into practice. Because responses elicited through interview surveys are self-reported, they are not always accurate due to personal motivations and power dynamics that may influence a participant to provide inaccurate responses. While questionnaires can be administered in a short period of time and efficiently, standardization with closed-ended and multiple-choice answers may reduce the complexity of the responses (Rust et al., 2017). Furthermore, perceptual data is often not objective, and can be prone to cognitive and social biases (Aswani et al., 2018;

Papworth et al., 2009). For example, ecological knowledge of individuals and communities are not permanent nor static, but instead is responsive to environmental and social change (Aswani et al., 2018). Additionally, accelerating environmental, social, and economic changes are rapidly eroding local, traditional, and indigenous ecological knowledge (Turvey et al., 2018), and the loss of such knowledge then reduces valuable evidence necessary to inform conservation (Turvey et al., 2018; Turvey, in press). In these cases, interviews using standardized questionnaires may in fact be advantageous because they can capture changes in perceptions by posing the same questions over time to the same or different participants and comparing the responses.

3.1 Ethical considerations

Because my research involved human participants, ethical considerations for working with people were carefully taken in account to protect the interviewees (Newing, 2011; Young et al., 2018). Ethical approval was sought and obtained from Royal Holloway University of London's Research Ethics Committee (ID 535). Free, prior, and informed consent was given by the interviewees verbally prior to beginning the interviews, after the researchers introduced themselves as students conducting research about the environment. Interviews were completely anonymized, and interviewees were reassured that they could withdraw from the interview at any time and choose not to answer any question. However, even if individual identities of the interviewees cannot be linked to their responses to questions, it is not guaranteed that they or their communities may not be blamed even at the collective level, e.g., if a village was found to have higher rates of undesired behaviors it could reflect negatively upon all of the inhabitants in that village (St John et al., 2016). For this reason, questions were more focused on perceptions, awareness, and ecological knowledge, rather than behaviors, to minimize the real and perceived risks for the interviewees. During pilot surveys and numerous informal discussions with local people, it became evident that discussing views about wildlife and the environment in general was not seen as controversial (**Figure 2.4**). Additionally, local people were not reluctant to speak about previously unregulated but now prohibited activities such as hunting and trapping. During the survey, interviewees were reassured that answers of 'don't know' are perfectly acceptable and that there are no correct or incorrect answers to any question. It was also emphasized that the purpose of the surveys was to learn from the interviewees about their personal knowledge and experiences in the local area, rather than to 'test' or judge them.

Figure 2.4 Left, having an informal discussion. Right, conducting interviews with questionnaires.

Transparency with local people and governmental authorities was ensured at all stages of the research. Where local university students were involved in the survey, the students' supervisor and university department provided a letter of support stating the names of all researchers and the objective of the research. Because the interviews took place in villages outside the protected area, there was no process nor requirement for obtaining research permits. Local government bureaus were contacted and were presented the university's letter of support when necessary. Logistical support and additional local information were given by officials in the Hainan Provincial Forestry Bureau. However, local governmental officials did not accompany the researchers during data collection, because doing so could risk making the interviewees nervous and in some cases may impact the interviewee's responses (Davies & Wismer, 2013). Overall, our positionalities as students helped us gain the trust from interviewees. The involvement of university students is part of the collaboration between ZSL's Hainan gibbon project and Hainan University which supports capacity building opportunities such as providing field experiences. Student research assistants will be co-authors on any publications and the support of any other individuals will be fairly acknowledged (Brittain et al., 2020).

3.2 Data collection

Research in this thesis was undertaken by conducting structured interviews using standardized questionnaires. The approach was taken because the key questions investigated involve hypothesis-testing of relationships between different factors affecting local perceptions of wildlife and conservation issues. Questionnaire-derived data allow for statistical analysis while

controlling for the influences of demographic attributes on the response variables of interest. Furthermore, because the ultimate objective of the research questions is to inform conservation management, comparisons and generalizations across the study site need to be made. Therefore, adopting a standardized questionnaire approach, conducted via individual face-to-face interviews, was most suitable for gathering data to answer the research questions in rural Hainan (**Figure 2.4**). Questionnaires were not self-administered because local people in the study system have low levels of formal education overall, and many are illiterate. Many questions were open-ended, which allowed for the interviewees to elaborate in detail if they wished, and by doing so the questionnaire could capture nuances and additional insights relevant to the research questions.

Chapter 3's data were obtained from a previous interview survey conducted by the Zoological Society of London in 2015 focusing on sighting records and local ecological knowledge of native mammal species. Results from these studies have been published in (Nash et al., 2016; Turvey et al., 2017, 2019). In this previous survey, other data on local people's reported access and perceptions of forest-derived natural resources were gathered at the same time, and this preexisting dataset was analyzed in this thesis. Ethical approval was obtained from the Zoological Society of London (BPE 0710). Additional details regarding data collection methods have been published in Nash et al. (2016) and Turvey et al. (2017, 2019).

Chapter 4 and Chapter 5's data were collected by me and a team of four undergraduate students at Hainan University. The students were recruited from the School of Forestry at Hainan University and were volunteers. They were trained in interview methods first, then carried out pilot surveys in pairs to familiarize with the questionnaire, village setting, interacting with local people, and recording data. Debriefing and discussions were held with the team at the end of each day to share insights. A pilot survey was conducted by me in November 2018 in villages around Wuzhishan National Nature Reserve, and again with the research team in February 2019 in villages around BNNR. Both pilots were conducted in villages that were not in the sampling design to avoid repeating interviewing the same people. Data collection was conducted in March and April 2019.

Chapter 6's data were collected by Junfei Qian, a master's student in Imperial College's conservation science course in 2017. A pilot survey was conducted by Junfei and me in May 2018 in villages that were not included in the final sample, and data were collected in July 2018. The interview survey contained questions designed by me and Junfei separately, but the demographic information was shared in the analysis by both of our studies. Results from the master's project are to be published in Qian et al. (2021).

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CHAPTER 3

Variation in local people's reported use of protected areas in Hainan: Insights for conservation case studies

ABSTRACT

The effectiveness of conservation interventions depends on the context of the system being conserved. Because variation in human knowledge, attitudes, behavior, and socio-economic circumstances is increasingly recognized as a factor underpinning conservation outcomes, there is value in using conservation case studies to investigate how patterns and lessons learned from specific systems can be widely applied. We conducted a large-scale interview survey in 2015 of rural communities around seven protected areas across Hainan Province, China, and investigated variation in interviewee forest use, including spatial variation and relationship with demographic variables. The protected area that someone lived nearest was the most frequent predictor of variation in forest use indices. Age also predicted some variation but rarely did other demographic characteristics. Conservation management can be improved by engaging with communities about natural resource access and attitudes towards conservation policies. Variation between different protected areas especially highlights the need to integrate local differences into management across mosaic landscapes.

KEY WORDS: Case study; heterogeneity; interview survey; livelihoods; social-ecological system

INTRODUCTION

Conservation management in social-ecological systems is often challenging because each system has specific natural and human characteristics (Pyhälä et al., 2016; Bennett et al., 2017; Amano et al., 2018). Understanding landscape-scale variation in habitat and climatic variables and species assemblages is important for management of heterogeneous and human-modified systems (Tabarelli et al., 2010; Lindenmayer et al., 2008; Fuhlendorf et al., 2016), and variation in socio-cultural factors, management effectiveness, and governance must also be integrated within conservation decision-making (Knight et al., 2008; Cumming, 2011). Such variation can affect whether conservation lessons learned from one system can be applied to other systems, a particular concern in regions where conservation capacity is limited and resources must be used efficiently.

Case studies (the in-depth examination of a situation, condition, or problem) are used widely in disciplines such as law, teaching, environmental sciences and policy (Burns, 2017). Their exploratory nature can allow holistic understanding of issues where wider-scale quantitative approaches might be impractical or limited, and they can be particularly useful for tackling complex issues in social-environmental systems that require interdisciplinary approaches and systems-thinking (Wei et al., 2015). Reviews and meta-analyses of case studies can offer diverse perspectives unavailable from single studies (Hirschnitz-Garbers et al., 2011; Thondhlana & Cundill, 2017). However, while case studies are used often in conservation, more discussion on why, when, and how they are valuable, or how specific or general their conclusions are, would help make conservation recommendations more tailored to specific contexts. Ban et al. (2013) argued that there is a need for greater research to compare and synthesize multiple case studies on conservation outcomes under a unified framework, thus limiting the effective application of specific conservation activities. This approach is especially needed for understanding socio-ecological systems because various human dimensions are involved, including socio-economic, psychological, cultural, and political characteristics that are context-dependent and can vary greatly between sites and across scales. However, while case studies can identify factors that influence conservation effectiveness at local scales, generalizations from one context may not be appropriate or useful elsewhere, and should not be used to oversimplify and overinterpret (Hirschnitz-Garbers et al., 2011; Moon et al., 2016; Thondhlana & Cundill, 2017). Therefore, the value of case studies and their ability to provide useful conservation management insights from local to landscape and wider levels needs further investigation, especially in complex social-ecological systems.

Protected areas are a major tool for safeguarding biodiversity, but their effectiveness and the impacts they have on local people are widely debated (Agrawal & Gibson, 1999; Brockington 2004; Hayes, 2006; Anaya and Espirito-Santo, 2018). Reducing threats to biodiversity inside protected areas requires concerted management effort and cooperation of local communities (Leverington et al., 2010; Bruner et al., 2011; Amano et al., 2018). With increased application of social sciences in conservation, human dimensions such as knowledge, attitudes, and behaviour are increasingly recognized as key underpinnings of successful conservation outcomes in and around protected areas (Brockington, 2004; Schultz, 2012; Nilsson et al., 2016; Pyhälä et al., 2016; Bennett et al., 2017).

Local people's use and perceptions of protected areas are affected by numerous demographic characteristics, demonstrating the complexities in protected area management. Ecological knowledge and pro-conservation behaviours and attitudes are known to vary with age (Rao et al., 2003; Karper & Lopes, 2014; Turvey et al., 2010, 2018), with age-related patterns also associated with social and cultural factors such as time spent in natural environments (Koster et al., 2016). Gender shows varying human-environment relationships (Allendorf & Yang, 2017; King et al., 2018), with division of labour between genders often leading to men and women performing different roles and developing different relationships with the environment (Voeks, 2007; Caballero-Serrano et al., 2019). Human-environment interactions are also affected by other patterns of dependency on natural resources (Karper & Lopes, 2014; Turreira-García, 2018), and by social and cultural identities such as ethnicity and religion, which are associated with cultural practices, traditions and taboos that can influence knowledge, uses and values of biodiversity and natural landscapes (Li et al., 2014; Shen et al., 2015; Balima et al., 2018). Understanding not only the patterns of interactions between local people and protected areas, but also how and why they vary, is therefore important to guide effective landscape management (Bennett et al., 2017).

China is a megadiverse country that faces enormous challenges to protect its unique but severely threatened biodiversity (Liu et al., 2018). Ambitious plans to protect Chinese species and ecosystems have been implemented through the creation of numerous protected areas (Ma et al., 2017; Xu et al., 2017). However, China has a huge rural human population that has traditionally been dependent upon the availability of natural resources (Coggins, 2002; Liu et al., 2016). While Chinese protected areas are designed to be multiple-use through zoning, in reality their management often does not accommodate human development, resulting in continued exploitation of threatened species and degradation of good-quality habitat driven by local people's use of resources inside reserves (Hull et al., 2011). However, there has been little

systematic investigation of the specific patterns and drivers of local people's interactions with Chinese protected areas, how such activities threaten regional biodiversity, and how and why these interactions might vary between different social-ecological systems across China's conservation-priority landscapes.

In order to understand patterns and pressures of local resource use inside Chinese protected areas, and to investigate whether conservation-relevant information from one social-ecological system is comparable with other systems in the same landscape, we conducted an interview survey in rural communities around several protected areas in Hainan, China's southernmost province. Hainan is an island province in the South China Sea and part of the Indo-Burmese biodiversity hotspot (Myers et al., 2000). It has some of China's last remaining tropical primary forests and supports the sole surviving population of the world's rarest primate, the Hainan gibbon (*Nomascus hainanus*) (Turvey et al., 2015). However, human pressures are still driving habitat degradation, and poaching continues to threaten native wildlife (Zhang et al., 2010; Gong et al., 2017; Xu et al., 2017). The forest reserve network of Hainan therefore presents a unique opportunity and appropriate study system to study local people's reported activities inside protected areas and how these vary in relation to geographic location or demographic parameters. We investigated: 1) how often local people living close to different protected areas across Hainan visit the forests inside these reserves, and whether the frequency of forest visits has changed through time; 2) why they might *not* visit forests; 3) whether they wish to be allowed access to forests; 4) what activities associated with forests have economic value to local people; and 5) how much variation exists in these indices of forest use across protected areas, and what factors are associated with this variation. Our findings provide a new baseline for informing local management of Hainan's protected areas, and for assessing the usefulness of site-specific social science case studies for informing wider conservation planning.

METHODS

1. Data collection

An interview survey was conducted between January and April 2015 around five national nature reserves (NNRs; Bawangling, Diaoluoshan, Jianfengling, Wuzhishan, Yinggeling) and two provincial nature reserves (PNRs; Jiaxi, Limushan) in central and southwestern Hainan (**Figure 3.1**). These protected areas all contain monsoon rainforest habitat, and are surrounded by low-income rural communities mainly comprising Li and Miao ethnic minorities (Zhang et al., 2005).

Fieldwork was conducted to investigate the status of threatened regional biodiversity (Nash et al., 2016; Turvey et al., 2017, 2018, 2019), and data on local people's use of forests and natural resources were also collected.

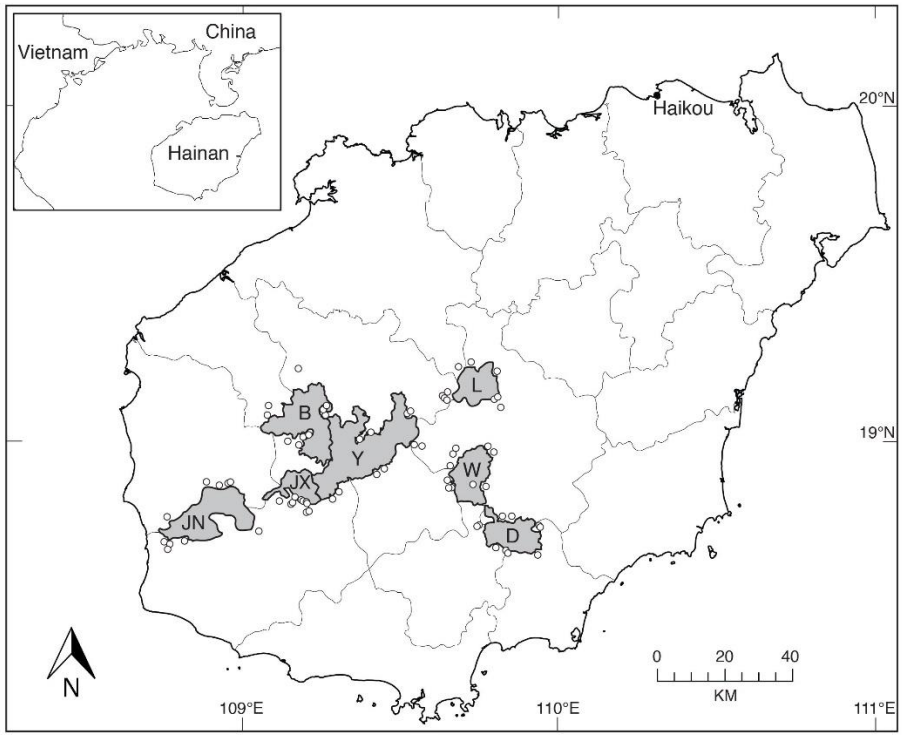

Figure 3.1 Map of Hainan, showing locations of villages around seven reserves where interviews were conducted in 2015. Key: B, Bawangling; D, Diaoluoshan; JN, Jianfengling; JX, Jiaxi; L, Limushan; W, Wuzhishan; Y, Yinggeling.

Data were collected through face-to-face interviews using a standardized semi-structured questionnaire (**Appendix, Questionnaire 1**). Ten villages were randomly selected around each reserve, from a wider sample of all villages situated close to the reserve boundary that were reported to utilize local forest resources by each reserve management office. Interviewees were selected by walking down the main road and conducting c.10 interviews opportunistically based on random encounters. Interviews were anonymous and were only conducted after free, prior, and informed verbal consent was given by interviewees. Detailed interview methods and protocols are provided by Nash et al. (2016) and Turvey et al. (2017). Ethical approval for this research study was granted by the Zoological Society of London's Ethics Committee (project registration number: BPE 0710).

2. Data analysis

Data analysis was conducted in R version 3.5.1 (R Development Core Team, 2017). Not all interviewees answered all questions, so sample sizes vary slightly between analyses. Some local people are employed as reserve wardens and are required to enter the forest for their job; analyses were therefore only conducted on data provided by interviewees who did not have forest-related jobs.

Binomial generalized linear models (GLMs) with logit-link functions and chi-squared tests were used to investigate patterns of reported forest use by interviewees: a) whether interviewees reported going into the local reserve; b) whether they reported going into the reserve more than once a month; c) whether they reported going into the reserve more frequently now compared to the past; d) whether they wanted to be allowed access into the reserve; and e) whether they reported "not allowed" as the reason for not going into the reserve (restricted to interviewees who reported they did not use the reserve, to investigate awareness of protected area regulations). We asked interviewees why they did not go into the forest and categorized these responses qualitatively. The terms "reserve" and "forest" were used interchangeably by interviewees.

GLMs were used to investigate whether reported forest use was predicted by the reserve that the interviewee lived closest to, and by demographic variables (age and gender). GLMs were only conducted for interviewees of Li ethnicity (86.2%, n=557) because other ethnicities (Miao, Han, Zhuang) together made up only 13.8% of the interviewee sample (n=89). Tukey post-hoc tests for pairwise comparisons were conducted for predictors showing statistically significant results. Village was also initially included as a random effect in a generalized linear mixed-effect model framework, but because R^2m (marginal) and R^2c (conditional) values showed little difference (differences ranged from 0.00 to 0.067 for 5 models), village was removed from models.

Chi-squared tests were used to investigate whether different indices of reported forest use were predicted by ethnicity (Li, Miao and Han ethnicities only, because only one participant reported Zhuang ethnicity). Model assumptions were not met for investigating whether interviewees reported going into the forest more than once a month due to low sample size for Han ethnicity for this question (four participants), so Han ethnicity was also removed for this analysis.

Reported reasons for not going into the reserve (by interviewees who reported not visiting; n=385), and reported activities and products derived from the forest that contributed to interviewees' income (by interviewees who reported visiting; n=240), were categorized and analyzed qualitatively. Answers of 'none' and 'don't know' were excluded. Responses from all

ethnicities were analyzed for both questions. These responses were grouped into nine activity categories; picking tea (n=3) was considered an agricultural activity because tea is a cultivated crop, and collection of plants consisted of three categories (medicinal; food; other uses, e.g. construction materials).

RESULTS

In total, 709 interviewees were interviewed. Of these, 646 interviewees had non-forest-related jobs (between 86 and 99 interviewees around each reserve) (**Table 3.1**).

Table 3.1. Demographic characteristics of people interviewed (n=646).

Demographic variable	Categories	Number	Percentage
Gender	Female	116	18.0
	Male	530	82.0
Ethnicity	Li	557	86.2
	Miao	74	11.5
	Han	14	2.2
	Zhuang	1	0.001
Reported going into the forest	Yes	241	37.3
	No	385	59.6
	No response	20	3.1
Age (years)	18-20	2	0.3
	21-30	63	9.8
	31-40	118	18.3
	41-50	182	28.2
	51-60	132	20.4
	61-70	68	10.5
	71-80	57	8.8
	81-90	22	3.4
	91-100	2	0.3
	Mean	Median	Range
	50.7	50 years	20-94 years

Of all 646 interviewees, 241 (37.3%) reported that they went into the nearby reserve. Reserve identity had a significant effect on reported responses (GLM, R^2=0.048, n=537; X^2=21.93, df=6, p=0.001), with Tukey post-hoc tests showing that significantly fewer interviewees living near Wuzhishan and Yinggeling reported going into the reserve compared to those living near Limushan (**Figure 3.2 A, Table 3.2**). Gender, age, and ethnicity were not statistically significant predictors (**Table 3.2**).

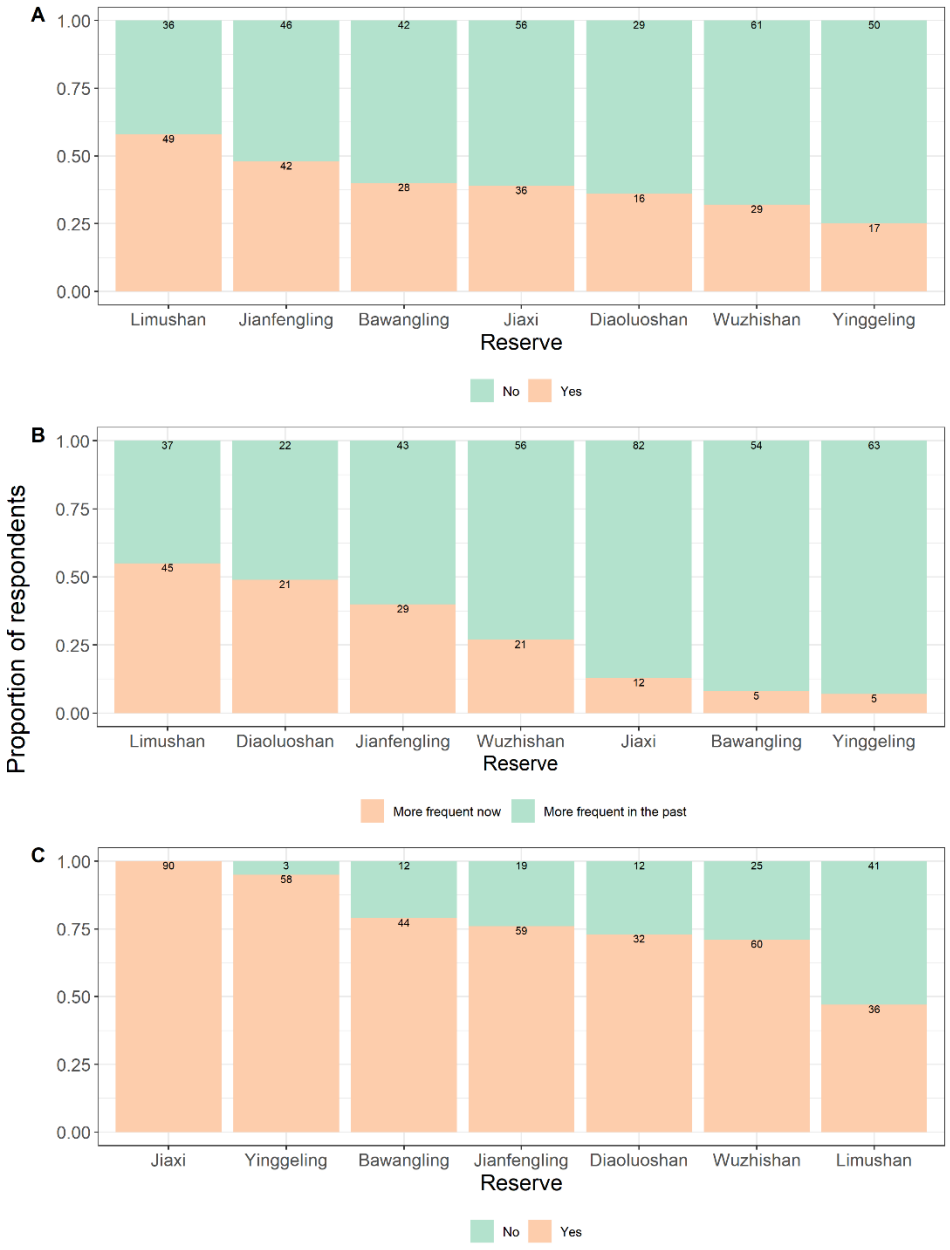

Figure 3.2 Responses of interviewees to different questions about forest access. Interviewees are people of Li ethnicity living near one of seven forest reserves in this study. **A**. Proportion of people who reported going into the forest; **B**. Proportion of people who reported going into the forest more frequently in the past than they do now; **C**. Proportion of people who expressed their wishes to be allowed to access the forest. Numbers on the bars show the total numbers of answers for each response. Bars are ordered in decreasing percentages of responses of "yes" in panels **A** and **C**, and responses of "more frequent now" in **B**.

Table 3.2 Variables that were not statistically significant predictors of local people's responses to questions about forest use and reserve access.

Response	Predictor	Analysis	n	X^2	df	p-value
Going into the forest	Gender	GLM	537	3.68	1	0.06
	Age	GLM	537	1.00	1	0.32
	Ethnicity	Chi-squared	625	5.52	2	0.06
Going into the forest more than once a month	Gender	GLM	217	1.57	1	0.21
	Ethnicity	Chi-squared	237	0.99	1	0.32
Going into the forest more frequently now than in the past	Gender	GLM	495	1.14	1	0.29
	Ethnicity	Chi-squared	574	0.21	2	0.90
Wish to be allowed access	Gender	GLM	490	2.32	1	0.13
	Age	GLM	490	0.92	1	0.34
	Ethnicity	Chi-squared	574	0.55	2	0.76
"Not allowed" as reason for not going into the forest	Gender	GLM	320	0.42	1	0.52

Overall, 162 of 646 interviewees (25.1%) reported that they went into the nearby reserve more than once a month. Reserve identity and age both had a significant effect on reported responses (GLM, R^2=0.131, n=217; *reserve identity*, X^2=14.105, df=6, p=0.028; *age*, X^2=13.334, df=1, p<0.001). Older people were more likely to report going into the reserve more frequently, whereas Tukey post-hoc tests showed no statistically significant differences between reserves (p>0.05 for all comparisons). Gender and ethnicity were not statistically significant predictors (**Table 3.2**).

A total of 415 of 646 interviewees (64.2%) reported going into the reserve more frequently in the past (**Figure 3.2 B**). Reserve identity had a significant effect on reported responses (GLM, R^2= 0.168, n=495; X^2=84.33, df= 6, p<0.001), with Tukey post-hoc tests showing significant differences between 11 comparisons of reserves (**Supporting Information Table 3.1**). The majority of interviewees living near to almost every reserve reported going into the reserve more frequently in the past, with a maximum of 82 of 94 interviewees (87.23%) living near Jiaxi. The exception was Limushan, where 45 of 82 interviewees (54.88%) reported going into the reserve less frequently in the past. Gender and ethnicity were not statistically significant predictors (**Table 3.2**).

Overall, 446 of 646 interviewees (69.0%) reported that they wanted to be allowed access to the reserve (**Figure 3.2 C**). Reserve identity had a significant effect on reported responses (GLM, R^2=0.176, n=490; X^2=97.520, df=6, p<0.001), with Tukey post-hoc tests showing significant differences between six comparisons of reserves (**Supporting Information Table 3.1**). The

majority of interviewees living near to almost every reserve reported that they wanted to be allowed access, with a maximum of 100% living near Jiaxi; the exception was Limushan, where only 36 of 86 interviewees (46.8%) reported that they wanted access. Gender, age, and ethnicity were not statistically significant predictors (**Table 3.2**).

For all interviewees (n=385), the four most frequently reported reasons for not going into the reserve were 'not allowed" (46.75%, n=180), "too old or disabled" (29.35%, n=113), "have other jobs or no time" (10.91%, n=42), and "conservation" (4.42%, n=17) (**Figure 3.3**). More interviewees living near Yinggeling reported "have other jobs or no time" than any other reserve, and the fewest interviewees living near Limushan reported "not allowed" than any other reserve. "Conservation" was only reported by interviewees living next to Diaoluoshan, Jianfengling, Limushan and Wuzhishan. "Nothing left" in the forest (3.12%, n=12) was reported by people living next to five reserves (Bawangling, Diaoluoshan, Limushan, Wuzhishan, Yinggeling). Reserve identity and age both had a significant effect on whether interviewees reported 'not allowed' (GLM, R^2=0.20, n=320; *reserve identity*, X^2=18.62, df=6, p=0.005; *age*, X^2=50.66, df=1, p<0.001). Younger people were more likely to report "not allowed", whereas post-hoc tests showed that significantly fewer interviewees living next to Limushan reported "not allowed" compared to those living near Diaoluoshan (p=0.042), Jianfengling (p<0.01), and Jiaxi (p<0.01), and more around Bawangling than those near Jiaxi (p=0.032), respectively. Gender was not a statistically significant predictor (**Table 3.2**). Chi-squared analysis showed that ethnicity also had a significant effect (n=384, X^2=6.31, df=2, p=0.043), with Han interviewees less likely to report 'not allowed' as the reason they did not visit the reserve.

Overall, 120 interviewees living next to Bawangling, Diaoluoshan, Jianfengling, Limushan and Wuzhishan reported activities conducted inside these reserves that contributed to their income (**Figure 3.4**). These interviewees ranged in age from 28 to 86 years old (mean=53 years), 86.7% were men (n=104), and 13.3% were women (n=16). The most frequently reported activity was collecting or cutting firewood (31.7%, n=38), followed by agricultural activities (17.5%, n=21), and hunting or trapping (15.0%, n=18). The collection of food plants, honey, medicinal plants, other plants, resources for miscellaneous uses, and cattle grazing were reported by fewer interviewees.

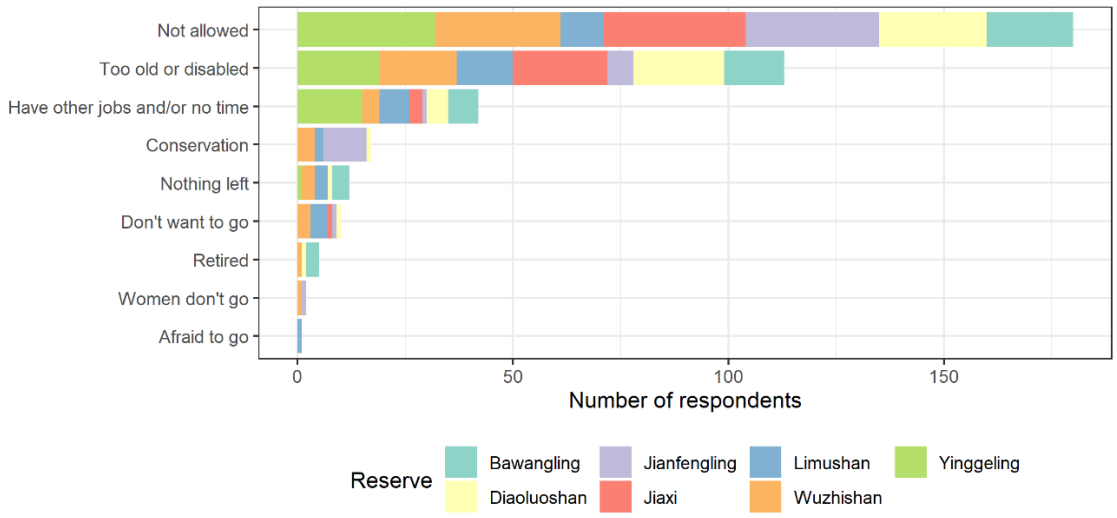

Figure 3.3 Reasons given by interviewees for why they do not go into the forest (n=385). Interviewees are people living near one of seven forest reserves in this study. Values on the x-axis indicate the numbers of people who provided each reason. There are more responses than the total number of people interviewed, because some people provided more than one reason.

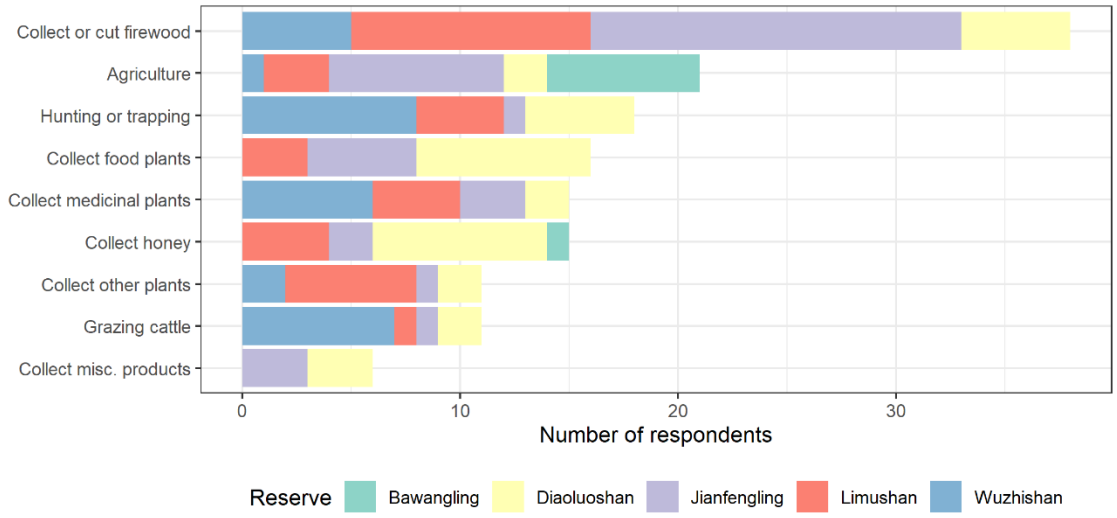

Figure 3.4 Activities identified by interviewees that are derived from the forest and contribute to their income (n=120). Interviewees are people living near one of five of the seven forest reserves in this study. Interviewees from two reserves (Jiaxi and Yinggeling) did not report forest activities. There are more responses than the total number of people interviewed, because some people listed more than one activity.

DISCUSSION

In our study, we demonstrate that interviewees living next to different forest reserves across central and southwestern Hainan show significant differences for all investigated indices of forest use and reserve access. Similarities in several responses were also reported across this study system; for example, more than half of interviewees around all reserves except Limushan expressed their wish to be allowed into their local reserve, reflecting a general attitude towards wanting access to natural resources. However, overall our results demonstrate considerable heterogeneity in interactions between local people and protected areas at a landscape scale in this conservation-priority region.

We found no significant effects of gender and only one significant effect of ethnicity in reported activities or attitudes associated with forest use. This result contrasts with several previous studies that have investigated gender as a possible determinant of attitudes and interactions with local environments (e.g., Cao et al., 2009; Allendorf & Yang, 2017; King & Peralvo, 2018). The observed lack of effect of gender on forest use in this study might be influenced by gender roles in rural environments in China. For example, women's participation in working on and managing farms has increased in rural Chinese agricultural systems since the 1990s, with women and men now having relatively equal access to resources, markets, and finances (Brauw et al., 2013). In our study communities, agriculture is the main mode of livelihood and production (Fauna & Flora International China Programme, 2005; Turvey et al., 2015); it is therefore reasonable that we also did not observe significant differences between genders in forest resource use and access. However, we recognize that our interviewee sample comprises an unequal representation of men and women, possibly reflecting the fact that women might be less likely than men to engage with external affairs or outside visitors in rural China (Entwisle et al., 1995; Matthews and Nee, 2000), and we recommend that future studies should aim to address this imbalance when investigating local people's relationships with protected areas.

Our results indicate that Han interviewees were less likely to report 'not allowed' as the reason for not going into the forest, which could suggest lower awareness of reserve regulations. This result could also be related to the recent migration of Han people into the mountainous interior of Hainan, and their lack of historical reliance on natural resources in contrast to Li and Miao indigenous communities (Chan et al., 2005; Marks, 2017; Turvey et al., 2018). More widely, variation in environmental knowledge and values associated with ethnicity can influence conservation both positively and negatively. The specific cultural and religious beliefs of different ethnic groups across China are known to protect sacred areas and deter the killing of

wildlife, but also to drive resistance to abandon traditional ways of life and use of natural resources in opposition to management restrictions (Li et al., 2014; Shen et al., 2015; Ho 2016; Li et al., 2016; Zhang et al., 2020).

Conversely, interviewee age was a significant predictor of variation in several reported interactions with local reserves. Although old age or physical infirmity constituted the second most frequently reported reason for not entering protected areas, older people were more likely to report going into their local reserve, and less likely to report "not allowed" as a reason for not doing so. This pattern might indicate that younger people are less interested in accessing local forests for resources, or have more awareness of protected area regulations and environmental issues due to increased access to education, media, and opportunities outside the local community (Rao et al., 2003; Reyes-Garcia et al., 2010; Rakotomamonjy et al., 2013). These findings are also consistent with an inter-generational erosion of indigenous ecological knowledge through a loss of connection with the environment, as also seen in other social-ecological systems in China and elsewhere (Zhang et al., 2014; Turvey et al., 2018). Indeed, rural-urban migration across China has resulted in younger, more educated people leaving villages to seek off-farm work opportunities (Liu 2008). Local conservation awareness-raising campaigns should therefore aim to target all age groups, because older people may lack exposure to conservation-relevant information, but younger people may lack experience and knowledge about local forests compared to their elders.

Spatial variation in reported patterns of forest use may reflect differences in reserve management and relationships with local communities. Different levels of law enforcement, awareness of protected area regulations and boundaries by local people, and poaching activities have been documented around Diaoluoshan, Limushan, Wuzhishan and Yinggeling (Wan et al., 2015; Gaillard et al., 2017). Gaillard et al. (2017) also noted that because Limushan is situated near a military base, local perception of strict law enforcement might deter poaching. However, we found that interviewees around Limushan were the most likely group to report going into the forest now, and the least likely to report going into the forest more frequently in the past, suggestive of greater human activity within this reserve. Multiple direct signs of hunting were also observed inside Limushan during a recent field survey to investigate the possibility of local survival of the Hainan gibbon (Turvey et al., 2017). In contrast, fewer interviewees living near Yinggeling reported going into this reserve compared to interviewees living next to other reserves, and Yinggeling has relatively high reserve management capacity and carries out

extensive regular monitoring, law enforcement, and local conservation awareness-raising and environmental education activities (Wan et al. 2015; Gaillard et al., 2017).

Similarly, spatial variation in reported reasons for not going into the forest might constitute further evidence that living next to a particular reserve influences local perceptions and responses to conservation management, with variation in interviewees reporting "not allowed" potentially associated with greater local awareness of reserve management regulations. Notably, relatively few interviewees around both Bawangling and Limushan reported "not allowed", which could reflect a lack of local conservation awareness. Indeed, despite high-profile conservation attention around Bawangling for the Critically Endangered Hainan gibbon, which is now globally restricted to this reserve, no interviewees reported "conservation" as a reason for not going into this reserve. As Bawangling was established as a protected area specifically to conserve the Hainan gibbon (Chan et al., 2005; Turvey et al., 2015), this potential indicator of limited awareness about management regulations in communities living adjacent to this reserve raises important concerns about the likely effectiveness of long-term protection of this species. Critical assessment of the effectiveness of previous awareness-raising campaigns around Bawangling is therefore required to understand local community perceptions of Hainan gibbon conservation, and our findings prioritize the importance of further targeted community engagement activities.

Subsistence collection of firewood was the top activity perceived by local people to have economic value within protected areas across Hainan. Globally, fuelwood consumption continues to place immense pressure on forest habitats and drives the loss of biodiversity (Zhang & Cao, 1995; Danielsen et al., 2010; Davidar et al., 2010; Spect et al., 2015). In social-ecological systems with dense low-income human populations, access to fuelwood is often perceived by local people as a benefit of living next to protected areas, and local support for conservation could be strengthened if this livelihood need is addressed and offset (Karanth, 2012). Our results therefore identify a potentially important conflict of interest between local people and reserve management, and suggest that if alternative, affordable fuel sources could be provided for low-income rural communities on Hainan, the need and desire to enter protected areas illegally could potentially be reduced.

However, availability of wage-earning jobs has also been positively associated with intensity of local fuelwood extraction, possibly because running small businesses requires more energy (Davidar et al., 2010). Furthermore, our interviewees also identified animal products collected from inside protected areas as having important economic value, supporting the findings of previous studies that have documented widespread trade in turtles and birds over the last two

decades on Hainan, with animals mainly sold in markets for profit rather than being consumed at home (Wan et al., 2015; Gaillard et al., 2017; Gong et al., 2017; Xu et al., 2017). We recommend that local people should be included in meaningful discussions with conservation managers to explore their desired reasons and potential opportunities for accessing reserves, and what past management practices might have impacted these responses, especially around Bawangling, Jiaxi and Yinggeling, which had the highest reported levels of local interviewee desire to use local forests. Opportunities for increased community engagement in decision-making should be explored further in Hainan (Fauna & Flora International China Programme, 2005; Turvey et al., 2015), to assess whether forest-dependent activities that local people find important could be permitted, regulated, or substituted for other non-forest-dependent activities. Importantly, it should not be assumed that all local livelihood activities necessarily pose threats to biodiversity (Salick et al., 2007; Urgenson et al., 2010). Likewise, without more comprehensive understanding of the types of activities and their respective impacts on protected areas, imposing alternatives could lead to unintended negative consequences (Hopping et al., 2018).

Case studies can provide important insights for many areas of conservation interest, by providing nuanced and in-depth analyses of the key components of particular study sites or systems (Wei et al., 2015; Burns, 2017). Indeed, in areas where conservation baseline data are limited or lacking and management capacity is varied, it can often be important to maximize the wider usefulness of conclusions drawn from local studies. However, findings from specific case studies may be of limited applicability or generality when considered in the wider context of social-ecological landscapes that can be highly diverse in both their natural and human components, in terms of knowledge, governance, attitudes, behaviour, culture, and economics. In this study, our results demonstrate considerable variation in conservation-relevant activities, motivations and attitudes between communities living around different protected areas across Hainan, indicating that an understanding of social-ecological interactions or conservation management lessons based on one site might not always be useful, effective or meaningful more widely even within the same region or landscape. Our study addresses the recognised data gap of needing more evaluation of case studies in conservation, especially studies focused on human-environmental relationships and whether these interactions support or hinder conservation effectiveness (Ban et al. 2013). We recommend that future studies should aim to address and incorporate additional socio-cultural parameters and phenomena to obtain a more multidimensional understanding of local people's relationships with protected areas. However, our results clearly demonstrate that a "one-size-fits-all approach" for conservation management would not constitute an effective strategy across

Hainan's forest reserves, which instead requires bespoke, targeted, and flexible site-specific responses determined by detailed appreciation of differing local baselines.

As management of many protected areas globally strives to become more inclusive and respectful of local communities through community-based conservation, emphasis should be placed on building a robust evidence-base around the issues specific to a particular study system or conservation dilemma (Berkes, 2004; Sutherland et al., 2004; Brooks et al., 2013). In Hainan and other systems where low-income communities live adjacent to protected areas and alongside threatened biodiversity within a larger varying landscape matrix, understanding locally important economic activities, motivations for using (or not using) natural resources, and key resource user groups on a case-by-case basis is necessary to provide a starting point for conservation interventions. Local livelihood needs should not be neglected in favour of infrastructural and economic development, especially with the imminent development of new national parks in China (Zhou and Grumbine 2011; Wang et al., 2012; Liu et al., 2020). Including local communities in dialogues about natural resource access and attitudes towards protected area policies would improve relationships with local management, help bridge the research-implementation gap, and make conservation governance fairer in complex socio-ecological systems (Ostrom 2009; Lele et al., 2010). Based on a foundational understanding of each system, appropriate conservation and development interventions can then be designed to meet the needs of local people (Berkes 2007; Oldekop et al. 2015). Only in this way can assumption and overgeneralization be avoided when building a foundation for dialogues between managers and communities that aim to reduce conflict and increase conservation success.

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SUPPORTING INFORMATION

Table 3.1 Tukey Post-hoc Test Results, pair-wise comparisons between respondents living next to different reserves.

1. Going into the forest

Comparison	Estimate	Std. Error	z value	Pr (>|z|)
Wuzhishan - Limushan	-1.02085	0.31629	-3.228	0.0211 *
Yinggeling - Limushan	-1.29623	0.35944	-3.606	0.0055 **

2. Going into the forest more frequently now than in the past

Comparison	Estimate	Std. Error	z value	Pr (>|z|)
Diaoluoshan - Bawangling	-2.3706	0.5613	-4.223	< 0.001 ***
Jianfengling - Bawangling	-2.0012	0.5269	-3.798	0.00261 **
Limushan - Bawangling	-2.6291	0.5225	-5.032	< 0.001 ***
Jiaxi - Diaoluoshan	1.9560	0.4473	4.373	< 0.001 ***
Yinggeling - Diaoluoshan	2.5268	0.5600	4.512	< 0.001 ***
Jiaxi - Jianfengling	1.5866	0.3971	3.995	0.00130 **
Yinggeling - Jianfengling	2.1573	0.5246	4.112	< 0.001 ***
Limushan - Jiaxi	-2.2145	0.3999	-5.538	< 0.001 ***
Wuzhishan - Limushan	1.1489	0.3415	3.364	0.01272 *
Yinggeling - Limushan	2.7853	0.5214	5.342	< 0.001 ***
Yinggeling - Wuzhishan	1.6364	0.5362	3.052	0.03467 *

3. Wish to be allowed access

Comparison	Estimate	Std. Error	z value	Pr (>|z|)
Limushan - Bawangling	-1.58051	0.41148	-3.841	0.00173 **
Yinggeling - Diaoluoshan	2.07252	0.68718	3.016	0.03120 *
Limushan - Jianfengling	-1.49353	0.37187	-4.016	< 0.001 ***
Wuzhishan - Limushan	1.06142	0.33413	3.177	0.01888 *
Yinggeling - Limushan	3.24107	0.64429	5.030	< 0.001 ***
Yinggeling - Wuzhishan	2.17965	0.64590	3.375	0.00964 **

CHAPTER 4

Local awareness and interpretations of species extinction in a rural Chinese biodiversity hotspot

ABSTRACT

Incorporating local perspectives is fundamental to evidence-based conservation, both for understanding complex socio-ecological systems and implementing appropriate management interventions. How local communities understand extinction, and whether these views affect perceptions of biodiversity loss and the effect of anthropogenic activities, has rarely been evaluated explicitly in conservation projects. To target this data gap, we conducted 185 interviews to assess levels and patterns of understanding about wildlife decline and extinction in rural communities around Bawangling National Nature Reserve, Hainan, China, a priority conservation site that has experienced recent species losses. Interviewees showed varying awareness of declines and extirpation of local wildlife species. Two-thirds did not consider the permanent disappearance of wildlife to be possible; among those who did, only one third could comprehend the scientific term ‘extinction’. Thinking extinction is possible was associated with identifying declined and extinct species, but not with perceiving locally-driven human activities, mainly hunting, as the reason for wildlife loss. The government was seen as the entity most responsible for conservation. Variation found around local perceptions of extinction, its drivers, and conservation responsibility demonstrates that comprehension of key conservation concepts should not be assumed to be homogenous, and highlights the challenge of transposing scientific concepts between different social and cultural contexts. Proactively incorporating local perspectives and worldviews, especially by obtaining local baseline understandings, has major implications for other contexts worldwide and should inform conservation planning and management.

KEY WORDS

Protected areas, local community, interview survey, resource use, *Manis pentadactyla*

INTRODUCTION

A key objective of conservation science is to understand the patterns and drivers of species declines and extinction to reduce the loss of biodiversity (Soulé, 2013). In the Anthropocene, human activities are driving the sixth mass extinction and pose the greatest threats to wildlife (Ceballos et al., 2015; Dirzo et al., 2014). A robust understanding of extinction is therefore needed to both reduce negative human impacts and support conservation actions. Extinction can be studied with different sources of data, including ecological surveys, assessments of species population trends and conservation status (Rodrigues et al., 2006; Collen et al., 2009), fossils and palaeoecological records (Turvey & Cheke, 2008; Turvey & Saupe, 2019), historical archives (Grace et al., 2019; Turvey et al., 2019), and local and traditional ecological knowledge (Aswani et al., 2018). Multiple sources of data yield more comprehensive understandings of species extinction, especially in data-poor contexts (Turvey et al., 2019). The increasing emphasis on using evidence in conservation research and decision-making (Sutherland et al., 2004) also includes the integration of social science theories and methods to incorporate human dimensions (Bennett et al., 2017; Moon et al., 2019). Local people often interact closely with the environment and are directly involved in activities negatively impacting biodiversity, such as hunting, habitat degradation, and human-wildlife conflicts (Dickman, 2010; Specht et al., 2015; Roe and Booker, 2019). Hence, to understand extinction patterns and processes, researchers and practitioners can benefit from proactive engagement with local people's perceptions, knowledge, and experiences (Bennett, 2016; Pyhälä et al., 2016). In many cases, local people are also the focus for conservation interventions aimed at altering awareness and behaviors (Nilsson et al., 2016), but effectively doing so requires baseline understandings of local perceptions.

Ample evidence shows that local people can have ecological knowledge about wildlife that others from outside the community might lack, and may also have different processes of knowing the environment compared with that of formally trained scientists (Berkes, 2009; Wheeler and Root-Bernstein 2020). When engaging with multiple stakeholders in conservation, establishing mutually understood concepts should be a priority, and would help diverse actors work towards a common goal. Conversely, a lack of shared understanding can be problematic as conflicts can arise from disagreements between stakeholders. For example, the rewilding movement has been hindered by the lack of consensus among stakeholders on key ecological concepts, such as what is 'wild' and 'natural', and on whose land should rewilding be done (Nogués-Bravo et al., 2016; Root-Bernstein et al., 2018). Addressing how people understand—or do not understand—

fundamental conservation concepts such as species decline and its causes should therefore be a key objective in conservation management to reach common ground between stakeholders.

In these contexts, reaching a common understanding of extinction is therefore key to conservation. The concept of extinction in Western scientific thought emerged in the 19th century after Cuvier demonstrated the phenomenon with evidence from the fossil record (Rudwick 1998). This realization only came after several centuries of European exploration and colonization, which catalyzed rapid anthropogenic environmental change around the globe that directly led to numerous documented species extinctions, including the dodo (*Raphus cucullatus*), now the symbol of extinction (Turvey & Cheke, 2008). Nonetheless, the philosophical and intellectual framework, and even the necessary language and terminology, around the concept of extinction was lacking at first, which has subsequently been perceived to have been an obstacle to further study of extinctions (Sodikoff, 2011; Wiens et al., 2020). Today, conservationists work in diverse social, political, and cultural contexts directly with local people with independent intellectual traditions and worldviews that might not necessarily contain comparable concepts of extinction (Brooks et al., 2013; Albuquerque et al., 2019). Actively engaging with potentially different perspectives, especially in regions with a high diversity of belief systems and languages that often overlap with biodiversity hotspots (Maffi, 2005; Turvey & Pettorelli, 2014), would help guide conservation management. However, establishing a baseline of how local people view extinction, while important, is often a missing step in conservation planning and management.

While the cultural significance of extinction has been studied through anthropological, psychological, and historical frameworks (Poling & Evans, 2004; Sodikoff, 2011; Rose et al., 2017), research on how non-scientists view the phenomenon of extinction and its implications for conservation is limited. A comparison of schoolchildren's understanding of the death of individual animals with the disappearance of entire species (e.g. dinosaurs), and of the acceptance of the possibility of human extinction among adults, showed that demographic variation exists even in the same cultural context (Poling & Evans, 2004). Past extinctions can also indicate how losses of species were perceived. For instance, Maori linguistic and oral traditions have been interpreted as reflecting local observations that the extinction of moa, an important food source, was driven by human exploitation (Wehi et al., 2018). Assessing current perceptions of species loss in traditional communities living within biodiversity-rich regions would therefore contribute more direct insights to inform management today and in the future.

Research on species of conservation priority has sometimes explicitly investigated local peoples' perceptions of the drivers of wildlife decline and extinctions, and has revealed further variation in perceptions and awareness within these social-ecological systems. For example, different cultural groups inhabiting the same area in the Dry Chaco, Argentina, have different perceptions of the species that have become locally extinct and the timeframes of these extinctions, despite a consensus that the overall decline and extinction of wildlife species was mainly driven by hunting (Camino et al., 2016). Some indigenous peoples also have terminology describing local animal extinction and beliefs that wildlife decline was caused by overhunting and/or habitat destruction, recalled primarily by older people from their own experiences and established without the influence of Western scientific concepts of extinction (de Azevedo et al., 2012; Forth, 2016). Conversely, other indigenous cultures appear not to have strong notions of extinctions being possible, such as not believing wildlife or the forest ecosystem could disappear, and these views may again vary according to demographic factors (Casanova et al., 2016). Differences in understanding endangered species decline have also been found between rural and urban residents in Brazil (de Azevedo et al., 2012). This complex variation in local understanding of extinction leads to further questions of what the underlying drivers of these perceptions might be, such as livelihood methods and associated patterns of resource use or cultural traditions. Finally, it should not be assumed that communities are homogenous entities, nor that they would automatically take on responsibility for sustainable environmental management (Agrawal and Gibson, 1999). Understanding how local people's perceptions of biodiversity loss relates to their sense of responsibility for conservation can therefore potentially be used to increase community involvement and a sense of ownership over natural resources, and promote pride, equity, and fair governance (Bennett et al., 2014; Nilsson et al., 2016).

In order to target these key data gaps in our understanding of extinction awareness, we investigated the following questions in village communities surrounding Bawangling National Nature Reserve (BNNR) in Hainan Province, China: a) whether and how local people understand species decline and extinction, and their respective drivers; b) what demographic variables affect these perceptions; c) whether people who think extinction is possible have favorable attitudes towards hunting, firewood collection, and use of natural resources; and d) who local people think should be responsible for conservation, and what factors influence whether someone thinks government authorities or citizens are responsible for conservation. The findings have major implications for how to engage proactively with local communities' views about biodiversity loss and associated local drivers, and for identifying shortfalls in conservation. Overall, our results

provide new understanding of human-wildlife relationships among non-Western rural communities around a key protected area, and contribute transferrable insights to inform conservation at wider scales.

METHODS

1. Study site

Interviews were carried out in villages within three kilometers from the border of BNNR (**Figure 4.1**). The reserve (18°57-19°11 N, 109°03-109°17 E) has an area of about 300 square kilometers and straddles two counties (Changjiang and Baisha Li Autonomous Counties). BNNR has been a priority for conservation management and scientific research partly because it contains the only surviving population of the Critically Endangered Hainan gibbon (*Nomascus hainanus*) (Chan et al., 2005; Turvey et al., 2015). Gun ownership and logging were banned in 2001 and 1994 respectively (Davies & Wismer, 2013), but forest degradation and exploitation of wildlife within BNNR and other protected forests in Hainan continue to threaten local biodiversity (Zhang et al., 2010; Gong et al., 2017; Xu et al., 2017). Large carnivores such as the Asiatic black bear (*Ursus thibetanus*) and clouded leopard (*Neofelis nebulosa*) have probably disappeared from the reserve over the last two decades, and other species such as the Chinese pangolin (*Manis pentadactyla*) are known to have undergone major declines (Fellowes et al., 2001, Turvey et al., 2019).

Villages tightly surround BNNR, with the nearest located within one kilometer from the reserve boundary. Local communities are predominantly of Li ethnicity, the indigenous people of Hainan, and with a few villages also comprised of people of Miao and Han ethnicity (Lian, 2003). Communities are typically low-income, with primarily agricultural-based economies, and relied on natural resources from the surrounding forest environment for food, housing, and cultural and spiritual uses until centrally planned conservation management of Hainan's forests began around 2000 (Fauna and Flora International 2005; Gu, 2019). Villages around BNNR naturally cluster in three areas (Bawang, Qingsong, and Wangxia), each of which share village-level government bureaus (*xiang*), shops and services, roads, and bus routes.

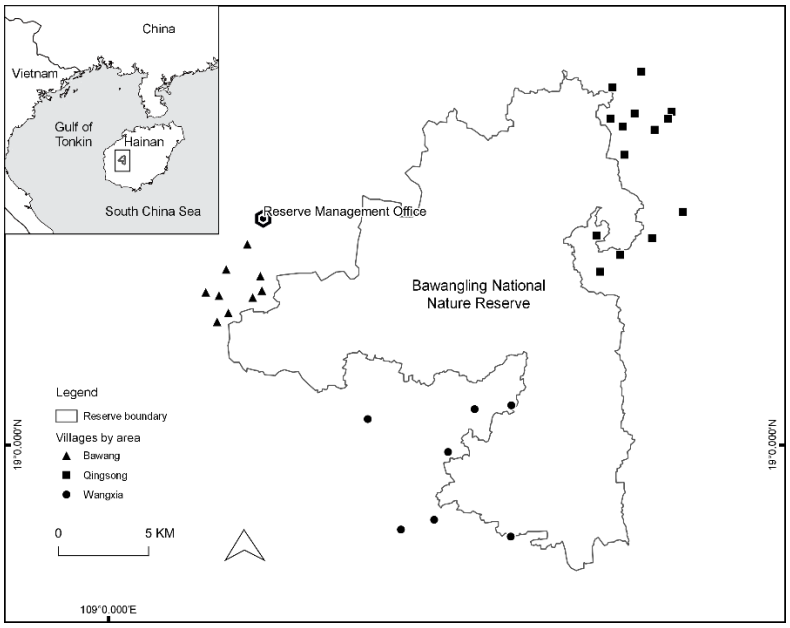

Figure 1. Villages visited in this survey around Bawangling National Nature Reserve in western Hainan, China.

2. Data collection

Interview surveys were conducted between February 27th, 2019 and April 1st, 2019 by a team of one PhD student and four local university undergraduate students. All of the villages within three kilometers of BNNR, a total of 30 villages (15 in Changjiang County, 15 in Baisha County), were visited (**Figure 4.1**). Individual household interviews with a questionnaire format were conducted by going door-to-door and asking whether local residents aged 18 or above would like to participate. A target number of 10 people per village was aimed for (Guest et al. 2006); however, this was not always achieved because in smaller villages there were few people at home or willing to be interviewed. Interviews were carried out following protocols outlined by White et al. (2005) and Newing (2011) and using methods previously used by Nash et al. (2016) and Turvey et al. (2017, 2019) in the same area. Participation was voluntary with verbal consent given before the interview began, and interviewees were informed that they could withdraw at any time or could choose not to answer any question. Standardized Mandarin was used in all interviews, which the interviewees could understand. The study was approved and supported by Hainan University College of Forestry and the Research Ethics Committee at Royal Holloway University of London (ID 535).

Using a standardized questionnaire with a mix of open and closed questions, information was first collected on interviewees' demographic characteristics, including gender, age, ethnicity and highest level of education (**Appendix**, Questionnaire 3). Interviewees were then asked whether they perceived any change in the overall abundances of local wildlife populations during the time they had lived in their village. Those who perceived an overall decline were also asked to list what caused wildlife decline and extinction separately. All interviewees were asked to free-list species they believed to have declined and become extinct from the surrounding area. They were also asked whether they considered it was possible for extinction to occur, by answering 'is it possible for animals to disappear and never appear again?', followed by asking what they thought the word 'extinction' ('*miejue'*) meant. To assess the relationship between relying on the reserve for resources and responsibility for conservation, interviewees were then presented with statements about three locally-driven human behaviors (it is acceptable to hunt, use natural resources from the reserve, and use firewood) and were asked to respond with agree, disagree, or neither agree nor disagree. They were then asked who they thought should be responsible for doing conservation. Interviewees could respond with 'don't know' to any question, and could give more than one answer for all open-ended questions. Additional data collected in this interview survey have been analyzed separately in Chapter 5.

3. Data analysis

Responses about perceived change in overall wildlife abundances were totaled for each of the possible categories (no change, increased, decreased, don't know). The most frequently mentioned declined and locally extirpated species were identified by summing the number of people who free-listed each species. Reasons for decline and extinction were categorized as either locally-driven human activities (e.g. hunting, deforestation) or other drivers that are the result of regional or global changes (e.g. climate change). Responses to whether local or non-local people's activities caused wildlife decline, and attitudes towards hunting and using natural forest resources or firewood, were summed across all interviewees and converted to proportions. Responses from open-ended questions for who should do conservation were grouped into five categories (reserve management, government, citizens, conservation professionals, and other), because different levels of specificity were given by interviewees for each category. For example, provincial and village level government were grouped with other levels of government, and forestry wardens were grouped with reserve management.

All statistical analyses were performed in R version 3.5.2 (R Core Team 2018). Generalized linear models (GLMs) with binomial error distributions and logit link functions were used to

determine which demographic variables were associated with: 1) thinking wildlife abundances have undergone overall decline; 2) thinking extinction is possible; 3) being able to free-list any locally declined species; and 4) being able to free-list any locally extirpated species. All response variables were binary (yes or no). Model predictors included age (continuous), gender (categorical), village location (categorical), and formal education level (categorical). Education level was divided into four categories (none; primary school; middle school; and high school and above, including university). Only people of Li ethnicity were included in GLMs due to the imbalance in relative frequencies of interviewees belonging to different ethnic groups in our sample (92.4% Li, 6.6% Miao and Han). The same predictors, plus whether someone thought extinction is possible, were also used in GLMs with the binary response variables of: 1) thinking local human activities caused wildlife decline; 2) thinking local human activities caused wildlife extinction; 3) thinking it is acceptable to use natural resources from the forest; 4) thinking citizens should be responsible for conservation; and 5) thinking the government should be responsible for conservation. Over 80% of interviewees reported that they were against hunting and in favor of firewood use, and so Fisher's Exact test was used instead of GLMs to test for associations with these variables. Chi-square tests were used to investigate whether there was an association between free-listing any locally extirpated species and thinking extinction is possible.

RESULTS

A total of 185 people in 30 villages were interviewed (**Supporting Information Table 4.1**). People interviewed per village varied from 2 to 20 because in several villages there were few people at home or willing to participate. Two-thirds of interviewees were from villages in the Qingsong area. The majority of interviewees interviewed were of Li ethnicity (92.4%), about two-thirds were men (70.2%), and overall they had relatively low levels of formal education, with most having only reached middle school (88.6%).

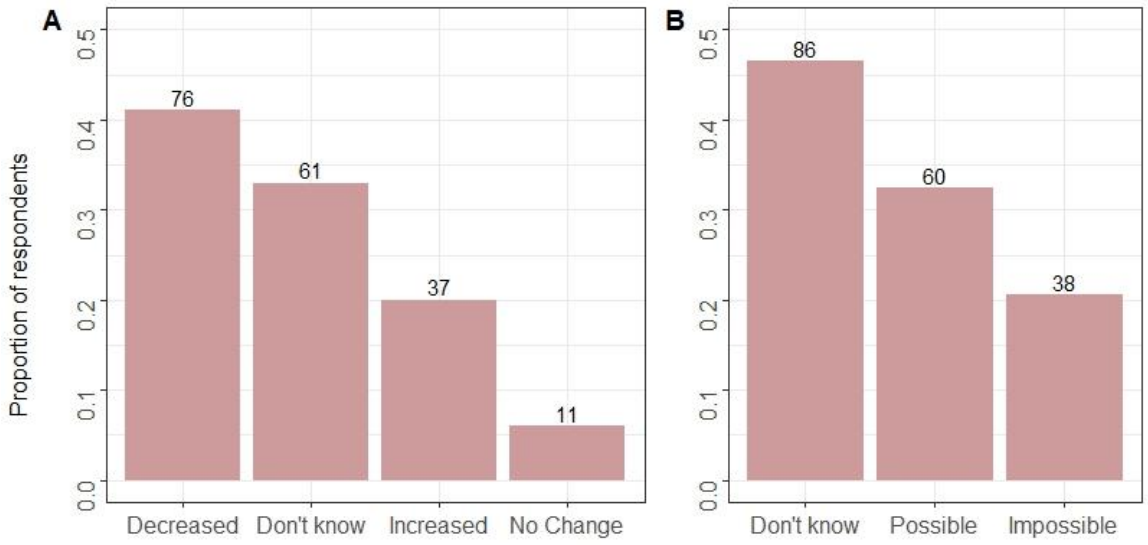

Figure 4.2. A) Interviewees' perceptions of change in wildlife populations over the time they have lived in their village (n = 185). **B**) Interviewees' perceptions of whether extinction of wildlife is possible or not (n = 184).

Less than half (76, 41.1%) of all interviewees perceived a decrease in wildlife populations, in contrast to the number of interviewees who perceived an increase (37, 20.0%) (**Figure 4.2A**). Many people did not know whether wildlife populations had changed (61, 30.3%), while very few people (11, 5.9%) thought there was no change. Age (binomial GLM, n = 169, $\chi^2 = 11.748$, df = 1, p = 0.001) and village location (binomial GLM, n = 169, $\chi^2 = 8.814$, df = 2, p = 0.012) were significantly associated with whether someone was more likely to perceive a decline in wildlife populations. Older people (estimate = 0.043, standard error = 0.015, z-value = 2.968, p = 0.003) and people in Qingsong (estimate = 1.332, standard error = 0.522, z-value = 2.554, p = 0.011) and Wangxia (estimate = 1.461, standard error = 0.632, z-value = 2.310, p = 0.021) were more likely to think wildlife had declined. Gender and education were not significantly associated with perceiving a decline in wildlife (**Supporting Information Table 4.2**).

Of all interviewees, 86 (46.5%) were not sure whether wildlife species could go extinct based on the description of the concept of extinction (**Figure 4.2B**), while 60 (32.4%) thought it was possible, and 38 (20.7%) thought it was impossible. Age (binomial GLM, n = 168, $\chi^2 = 11.670$, df = 1, p = 0.001) and village location (binomial GLM, n = 168, $\chi^2 = 6.854$, df = 2, p = 0.032) were significantly associated with whether someone was more likely to think extinction was possible, but gender and education were not (**Supporting Information Table 4.2**). Older people were

more likely to think extinction is possible (estimate = 0.045, standard error = 0.015, z-value = 2.988, p = 0.003), but there were no significant differences between the three village locations detected by post-hoc tests. An association was found between considering extinction to be possible and being able to list locally extirpated species (chi-squared test, $\chi^2 = 28.189$, n = 183, df = 1, p-value < 0.001); more people both recognized local disappearance of wildlife and thought extinction is possible than expected (36 observed vs 20 people expected).

In contrast, of the 60 people who though extinction is possible, 37 (61.7%) people did not understand the scientific term 'extinction', while 21 (35%) provided an explanation of what it meant. Definitions of extinction given by interviewees typically included 'animals have disappeared forever', 'all died out', and 'all got killed or captured'. Of the 124 people who were not certain extinction is possible, 38 (30.6%) still described the meaning of the term extinction, while 86 (69.4%) people were neither certain about extinction nor understood the term. In addition, three people said dinosaurs went extinct in the past, but it is impossible for animals to go extinct now.

In total, 60 interviewees (32.4%) were able to free-list at least one species they perceived to have gone extinct locally. Only four species were thought by more than five people to have become locally extirpated: Chinese pangolin (*Manis pentadactyla, n = 26*), red muntjac (*Muntiacus muntjak*, n = 11), Asiatic black bear (n = 10), and sambar deer (*Rusa unicolor*, n = 7) (**Figure 4.3A**). In addition, four people mentioned civets (with two people specifically naming masked palm civet *Paguma larvata*); three people mentioned turtles (including two who named golden coin turtle *Cuora trifasciata*); fish and toads were each mentioned once; and birds were not generally identified to species group or species level, except for pheasant (two), owl (one), crested myna (one) and parrot (one). Age (binomial GLM, n = 167, $\chi^2 = 7.779$, df = 1, p = 0.005) and village location (binomial GLM, n = 167, $\chi^2 = 11.888$, df = 2, p = 0.003) were significantly associated with someone being able to name at least one species perceived as being locally extirpated. Older people (estimate = 0.033, standard error = 0.015, z-value = 2.283, p = 0.022) and people in Qingsong (estimate = 1.819, standard error = 1.819, z-value = 2.760, p = 0.015) compared to Bawang were more likely to identify at least one locally extirpated species (**Supplementary Information Table 4.3**).

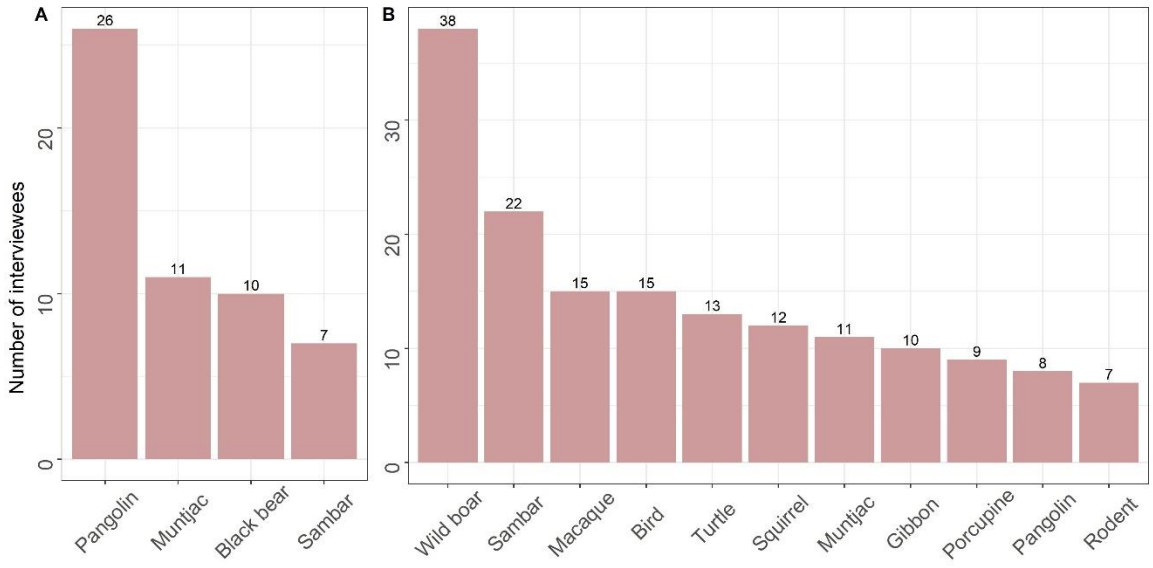

Figure 4.3. A) Wild animals that at least five interviewees thought have been locally extirpated (n = 60). **B)** Wild animals that at least five interviewees thought have declined (n = 81).

Among all interviewees, 81 (43.8%) were able to free-list at least one species they perceived to have declined. In total, 11 species or species groups were identified by at least five people. The most frequently mentioned declined species were wild boar (*Sus scrofa*, n = 38), sambar deer (n = 22), rhesus macaque (*Macaca mulatta*, n = 15), and birds (n= 15) (**Figure 4.3B**). Of the 13 people who mentioned turtles, three specifically identified golden coin turtle, two identified big-headed turtle (*Platysternon megacephalum*), and one described a small aquatic turtle. Most listed wildlife were again mammals, but also included pheasants, fish, insects, and snakes, including one mention of pythons. Age (binomial GLM, n = 167, χ^2 = 7.403, df = 1, p = 0.007) and village location (binomial GLM, n = 167, χ^2 = 11.499, df = 2, p = 0.003) were significantly associated with someone being able to name at least one species perceived as being locally declined. Older people (estimate = 0.031, standard error = 0.014, z-value = 2.206, p = value = 0.027) and people in Qingsong (estimate = 1.3668, standard error = 0.4908, z-value = 2.785, p=value = 0.015) compared to Bawang were more likely to identify at least one locally declined species (**Supplementary Information Table 4.3**).

Many people stated they did not know the reasons for wildlife decline (106, 57.3%) or extinction (138, 74.6%). A range of local and non-local drivers were identified by those who stated that they did. Of the 76 people who reported reasons for wildlife decline, 62 (81.6%) identified at least one local human activity, while 12 (15.8%) identified other reasons (**Figure 4.4A**); two answers were

discarded due to ambiguity ('because of the government' and 'animals got protected'). In contrast, of the 43 people who gave reasons for extinction, 36 (83.7%) were able to identify at least one local human activity as the reason, while six (14.0%) listed other reasons (**Figure 4.4B**); one answer was discarded due to ambiguity ('animals got protected'). Of all interviewees, more thought local people were responsible for the activities causing wildlife decline (47, 25.4%) compared to those who thought that this was caused by non-local people's activities (35, 18.9%), but nearly two-thirds (122, 65.9%) of interviewees did not know.

The most frequently identified cause for both wildlife extinction and decline was hunting (**Figure 4.4**). Other causes driven by local human activities, including habitat loss and degradation (deforestation, land clearing or burning), disturbance by humans, and herbicide or pesticide use, were far less frequently listed. Interviewees with a higher education level were more likely to think wildlife extinction was caused by local human activities (binomial GLM, n = 164, χ^2 = 14.057, df = 3, p = 0.003), but no significant differences were found between education levels (**Supporting Information Table 4.3**). Village location was the only variable significantly associated with thinking wildlife decline was caused by local human activities (binomial GLM, n = 164, χ^2 = 14.460, df = 2, p = 0.001), with interviewees in Qingsong more likely to think local human activities were responsible (estimate = 1.614, standard error = 0.601, z-value = 2.684, p = 0.007). Thinking extinction is possible was not significantly associated with identifying local human activities as the cause of wildlife extinction and decline (**Supporting Information Table 4.2**).

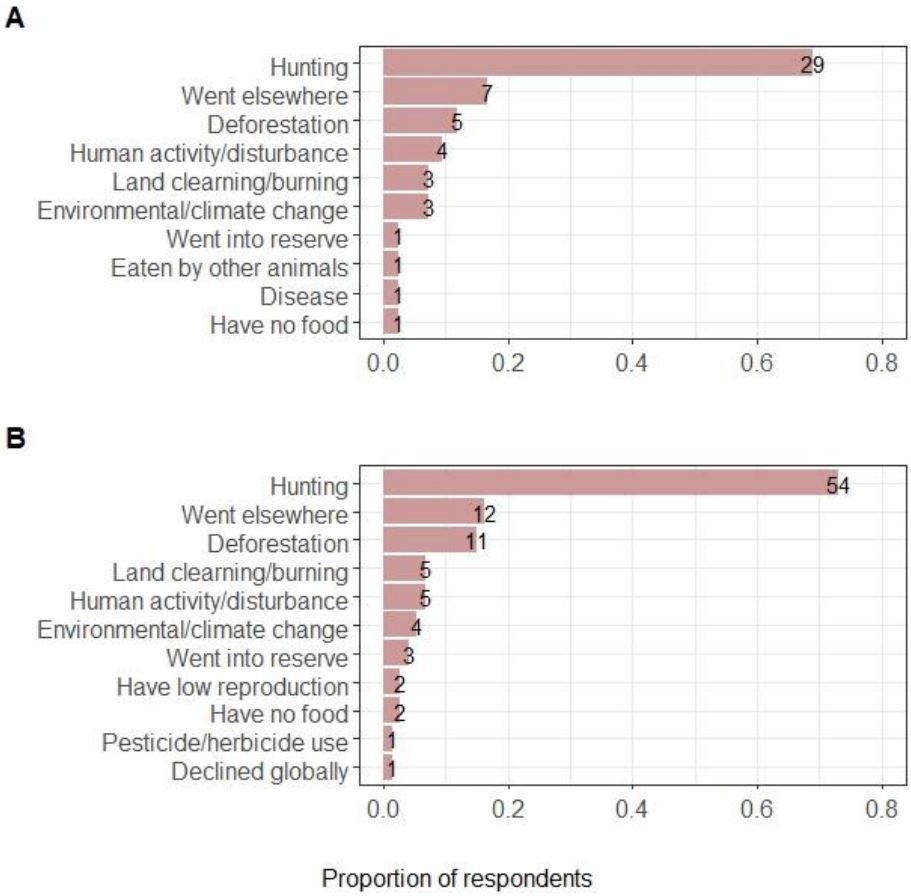

Figure 4.4 A) Interviewees' perceptions of the reasons for local wildlife extirpation (n = 43). **B)** Interviewees' perceptions of the reasons for local wildlife decline (n = 76).

Just under half of interviewees (45.1%) thought it was acceptable to use natural resources from the forest. Most interviewees (172, 94.5%) had a positive attitude towards using firewood for powering stoves for cooking. In contrast, most interviewees were against hunting (146, 80.2%), but some (24, 13.2%) had a neutral attitude (**Supporting Information Figure 4.6**). Thinking that extinction of wildlife is possible (binomial GLM, n = 166, $\chi^2 = 5.310$, df = 1, p = 0.021) and village location were significantly associated with thinking it is acceptable to use natural resources from the forest (binomial GLM, n = 166, $\chi^2 = 6.980$, df = 2, p = 0.031). Interviewees who thought extinction is possible were more likely to think it is acceptable to use natural resources (estimate = 0.846, standard error = 0.371, z-value = 2.279, p = 0.023), and those in Wangxia were more likely to think it is acceptable (estimate = 1.455, standard error = 0.578, z-value = 2.519, p = 0.012) (**Supporting Information Table 4.3**). There was no association between whether an interviewee thought extinction is possible and whether they thought it is

acceptable to use firewood (Fisher's Exact Test, n = 168, odds ratio = 2.07, 95% confidence interval = 0.39-20.67, p = 0.49), or that it is acceptable to hunt (Fisher's Exact Test, n = 168, odds ratio = 1, 95% confidence interval = 0.21-3.94, p = 1).

Of all 185 interviewees, most interviewees (165, 89.2%) thought wildlife should be protected. Among these, 137 (74.1%) identified at least one group of people they thought should be responsible for conservation, while 28 did not know (15.1%). Sixteen people (8.60%) were unsure whether wildlife should be protected, and one person (0.05%) did not think so. Of the interviewees who thought wildlife should be protected, reserve management was thought to be responsible by the most people (64, 46.7%), followed by ordinary citizens (60, 43.8%) and various levels of government bureaus (43, 31.4%) (**Figure 4.5**). Only five people (3.6%) thought conservation professionals should be responsible for conservation.

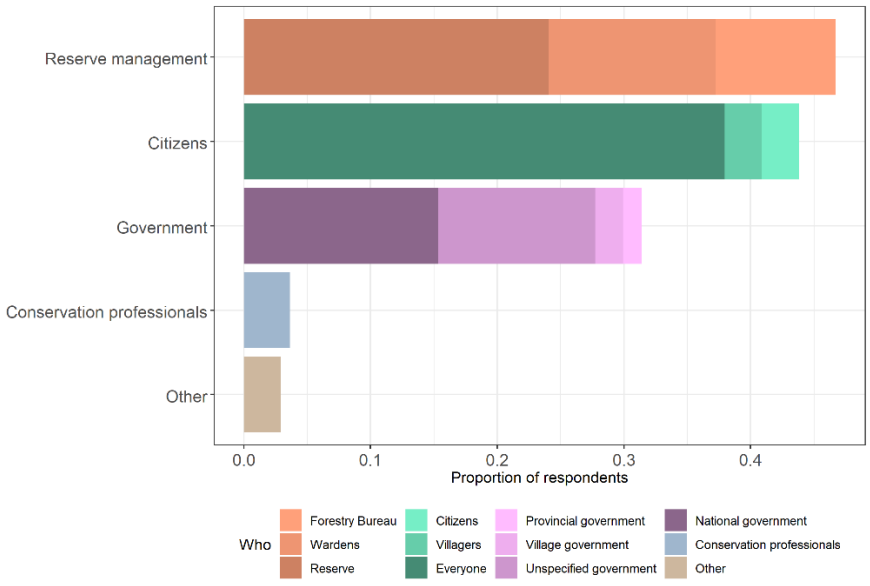

Figure 4.5. Interviewee opinions on who they considered should be responsible for conservation (n = 137).

Demographic variables and perceptions of extinction had varying effects on perceptions of responsibility for conservation. Age (binomial GLM, n = 162, $\chi^2 = 6.423$, df = 1, p = 0.011) and education level (binomial GLM, n = 162, $\chi^2 = 24.638$, df = 3, p < 0.0001) were associated with thinking all citizens are responsible for conservation, with younger people (estimate = -0.03875,

standard error = 0.01617, z-value = -2.396, p = 0.017) and those with higher education more likely to think all citizens are responsible (**Supporting Information Table 4.2**). Age was also associated with thinking the government is responsible for conservation (binomial GLM, n = 165, χ^2 = 12.351, df = 1, p < 0.001), with older people more likely to hold this opinion (estimate = 0.04729, standard error = 0.01482, z-value = 3.190, p = 0.001). Gender, village location, and whether someone believed extinction is possible were not significant predictors of whether interviewees held either opinion (**Supporting Information Table 4.2**).

DISCUSSION

In order to develop appropriate methods to mitigate unsustainable interactions between local communities and threatened biodiversity, it should neither be assumed that all cultures share the western scientific understanding of extinction, nor that people not exposed to western scientific thinking cannot comprehend extinction (Forth, 2016; Casanova et al., 2014; Wehi et al., 2018). Understanding local perceptions of extinction and associated world views, knowledge levels and attitudes is essential to avoid erroneous assumptions in conservation planning, and to enable stakeholders to reach a shared consensus about conservation issues and goals. We addressed this data gap by evaluating the understanding of species extinction and decline around a key protected area in Hainan, China.

Responses to free listing questions indicate that a relatively large proportion of people living close to BNNR are aware of local species declines. While there have not been regular systematic wildlife surveys inside the reserve (Fellowes et al., 2001; Chan et al., 2005; Lau et al., 2010), other recent interview surveys conducted around BNNR provide independent data on reductions in sightings of several mammal species, and are consistent with local perceptions of wildlife decline documented in this study (Nash et al., 2016; Turvey et al., 2019; Wang et al., 2021). Furthermore, continued hunting of birds and turtles is documented in adjacent reserves in Hainan, and local people in these landscapes perceive that population declines are caused by overhunting (Gong et al., 2009; Liang et al., 2013, Gong et al., 2017). Awareness of the potential for local wildlife decline is well documented in both environmental history and other traditional societies. For example, sustainable hunting and fishing practices exist among many indigenous cultures (Berkes et al., 2000, Wheeler and Root-Bernstein 2020). Formal governance structures, such as medieval European hunting regulations and forest conservation, also demonstrate past awareness of the risk of wildlife decline and a desire to prevent it (Young 1978). Similarly, environmental

conservation guidelines dating to the 11th century BC in China indicate that notions of local species decline influenced environmental management practices (Cui and Wang 2001; Marks 2007). Overall, these findings reaffirm the value of incorporating ecological knowledge in species conservation, especially in data-poor environments (Berkes et al., 2000, Turvey et al. 2010, 2014).

Responses to free listing questions also indicate that relatively many people living close to BNNR are aware not only of local species declines but also of local species extirpations, as reflected by the differences in the most frequently perceived locally extirpated species (pangolin, muntjac, black bear, sambar) and declined species (wild boar, sambar, macaque, birds, turtles). However, although we found that perception of local extirpation of species and an understanding of extinction being possible are linked, our results also demonstrate that a relatively low proportion of interviewees considered that the permanent disappearance of animals is possible. While culturally salient extinction 'icons' exist in both western and eastern societies (Turvey and Cheke 2008; Heise 2010), the association between awareness of local extirpation and acknowledging global extinction is thus not necessarily obvious. For example, the Lewis and Clark expedition across western North America in the early 19th century was partly motivated by Thomas Jefferson's belief that mastodons are not extinct and might still exist somewhere in territories unexplored by western societies (Thomson, 2009). Therefore, whether there is a causal relationship between understandings of local extirpation and global extinction warrants further comparative research across social and cultural contexts.

A limited awareness of the possibility of extinction has also been documented elsewhere in other rural communities around protected areas. For instance, many local people living close to Cantanhez Forest National Park in Guinea-Bissau believed that neither wildlife nor the forest ecosystem would disappear, with such views related to religious beliefs (Casanova et al., 2014). The lack of concepts of extinction could potentially have roots in classical Chinese culture, which was heavily influenced by Buddhist, Taoist, and Confucian philosophies, in which human and animals are all components of nature and coexist in harmony (Grumbine and Xu 2011; Sterckx, 2019). In these belief systems, nature was a rather abstract construction, which may have been why understandings of concrete ecological phenomena were largely absent (Grumbine and Xu 2011), as extinctions were not believed to be possible until the 19th century in China (Marks, 2007). Instead, millennia-old philosophical traditions have promoted the moderate and sustainable usage of natural resources to prevent their depletion, indicating an understanding of concepts of biodiversity loss (Sterckx, 2019). Yet despite evidence of sustainable management

practices in both rural ethnic minority and Han communities (Coggins, 2003; Urgenson et al., Shen et al., 2015), the extent to which extinction is understood as an irreversible state is still largely unknown.

The low number of people who could explain the meaning of the scientific term 'extinction' ('*miejue'*), even among those who thought that the permanent disappearance of animals is possible, has further implications for conservation practice, especially for communication and awareness-raising. It is not surprising that this formal scientific term is not well understood by ethnic minority communities who live in rural settlements and have low levels of formal education. However, if the formal term is widely used in awareness-raising about conservation, mismatches in understanding could result in low uptake of the key messages being communicated. From our experience in Hainan gibbon conservation at BNNR, there is also a mismatch about understanding key aspects of extinction dynamics and risk between groups and individual actors involved with conservation management, e.g., government officials and researchers, resulting in the lack of consensus on the prioritization of conservation actions and relevant resources. If such levels of discrepancy can be found within one social-ecological system, it should be expected to be even more prevalent when transposing conservation concepts internationally between vastly different cultures and languages. Indeed, confirming species extinction is conceptually and practically challenging, an issue that is further hindered by the lack of recent evidence to assess possible continued survival of many rare and enigmatic species (Diamond 1987; Turvey et al., 2007). Therefore, local people should also not be expected to have a consistent understanding of extinction, especially considering the different experiences they have with the environment compared to those of authorities, researchers, and conservation professionals.

We also found that perceptions of both wildlife decline and extinction were further influenced by demographic and geographic factors. The association between older age and greater understanding of species loss may be attributed to more experience of local environments, consistent with other studies showing that community elders have more ecological knowledge (Turvey et al., 2010; Forth, 2016). In Hainan and elsewhere, erosion of local and traditional ecological knowledge has been found to accompany biodiversity loss and ecological degradation (Kai et al., 2014; Turvey et al., 2018). Conversely, the observed different levels of understanding of species loss between village locations around BNNR may reflect variation in levels of implementation of conservation awareness-raising activities in different communities around the protected area. The conservation flagship species of BNNR, the critically endangered Hainan

gibbon, has been the focus of most awareness-raising activities previously conducted in this region (Fauna & Flora International China Programme, 2007, 2008; Kadoorie Farm & Botanic Garden, 2018, 2019), and more conservation-relevant information focused around this species has been available from billboards, murals, and education activities in the Qingsong region (Qian et al. in press). The greater level of general understanding of species decline and extinction seen in the Qingsong region may thus suggest a potential link between exposure to gibbon-specific awareness-raising and higher levels of general extinction knowledge.

The most frequently identified reason for wildlife extinction was hunting, and very few people knew about any other drivers of decline or extinction. Awareness of hunting as a threat may reflect local people's direct personal experiences, either having hunted themselves or observed or heard from others such as village elders who hunted in the past. In a separate recent study, many local people also reported that their knowledge about threats to the Hainan gibbon came from experience of hunting or observing hunting activities (Qian et al., in press). Elsewhere, local people that traditionally practice subsistence hunting also have a high degree of consensus that hunting is the main driver of local biodiversity loss, and have proposed hunting restrictions as conservation solutions (Camino et al., 2016). To achieve a more robust evaluation of hunting threats, interview responses should be triangulated with other methods to evaluate the impact of different human activities, such as monitoring evidence of hunting such as traps and market surveys (Gong et al., 2009; Gaillard et al., 2017).

Local perceptions of the possibility of extinction, the species affected, and the causes of species decline have important implications for conservation awareness-raising activities. The overall low level of knowledge of species extinction and its drivers highlights the need to promote understanding of key conservation concepts when engaging with local communities. Variation in awareness about the relative impacts of hunting compared with other threats, such as habitat degradation and disturbance by human activities, suggests that future awareness-raising should include information not only on the conservation-priority species present in the landscape, but also on the various processes causing species decline. It is also important to assess if, how and where local human activities are currently impacting biodiversity to better focus awareness-raising and other mitigation measures to where they are most needed. Awareness-raising could be specifically designed to target the identified gaps in local understanding of extinction by emphasizing that the Hainan gibbon is only found in BNNR and nowhere else, the species' existence depends solely on habitat inside the reserve, and the likelihood of irreversible extinction increases without support for conservation actions.

To local people living close to BNNR, responsibility for conservation was primarily thought to be borne by the government, but the participation of the general public was also seen as important. Reserve authorities, including the forestry bureau, management office, and reserve wardens, were perceived to be most responsible for wildlife conservation, suggesting local people associate reserve staff the most with conservation or receive the most exposure to conservation from reserve staff. In contrast, few people identified conservation professionals as being responsible, possibly reflecting the more limited activities of the few conservation organizations active at BNNR, and their temporally and geographically patchy engagement with local communities (Kadoorie Farm & Botanic Garden, 2018, 2019, Fauna & Flora International China Programme, 2005, 2007, Turvey et al., 2014). Overall, national level government was perceived to be more responsible than provincial and village level government. The increased likelihood of older people to have this view may reflect the last few decades of state-led environmental management directives in recent Chinese history (Marks, 2017; Mao & Zhang, 2018). In contrast, younger people and those with higher education were more likely to think everyone is responsible, suggesting a potential shift towards the belief that conservation should involve all members of society. For example, birdwatching is increasingly popular in China, and many birdwatchers, typically those who are higher educated, younger, and wealthier, have expressed their environmental concerns (Walther & White, 2018), presenting opportunities for raising regional awareness about the extinction crisis through nature-based education and leisure activities.

Fair and ethical treatment of local people in conservation could be supported by understanding their attitudes towards conservation-relevant behaviors and activities. Around BNNR, the less favorable attitudes towards hunting, also found around other protected areas in Hainan (Wang et al., 2021), may be the result of messages communicated through awareness raising that emphasize reserve regulations and prohibited activities (H. Ma, unpublished data, Chapter 6). The most reported reason for not going into the reserve was because it is prohibited (H. Ma, unpublished data, Chapter 3). Some interviewees also stated that they did not know about the status of local wildlife and whether extinctions are occurring because they were not allowed into the reserve. Conversely, favorable attitudes towards collecting firewood may reflect a reliance on it for energy. Attitudes towards using natural resources (firewood, hunting, natural resources) were influenced by village location, perhaps because some villages are less connected to other sources of income and opportunities. However, the overall lack of association between having such attitudes and thinking extinction is possible suggests that preference for local resource use is

likely driven by socioeconomic conditions or other factors, rather than awareness of ecological phenomena such as extinction.

Overall, our results demonstrate the importance of proactively engaging with varying understandings of wildlife extinction, because doing so can help different stakeholders—local communities, researchers, and management authorities—reach consensus on the key ecological concepts underpinning conservation goals. The contrast between many interviewees acknowledging local wildlife extirpation but considering that extinction is not possible highlights the nuances within local perceptions of species decline. It is therefore important to avoid the assumption that people from varying cultural and socioeconomic backgrounds will have homogenous views of species extinction. Finally, our results also reaffirm the contributions of local ecological knowledge to understanding wildlife decline, and advocate for the inclusion of such knowledge as crucial evidence for conservation.

DATA AVAILABILITY

The datasets collected during this study are available from the corresponding author upon request. Data are not publicly available because they contain potential sensitive information on the interviewees' location, behavior, and personally opinions that may compromise their identities and safety. Research was approved by Royal Holloway University of London's Research Ethics Committee (ID 535).

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CONFLICT OF INTEREST

The authors declare no conflicts of interest.

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SUPPORTING INFORMATION

Table 4.1 Summary of demographic characteristics of all interviewees (n=185).

Variable			
1. Age (years)	**Mean**	**Median**	**Range**
	44	45	19-78
2. Gender	**Categories**	**Number**	**Percentage**
	Female	55	29.7
	Male	130	70.2
3. Ethnicity	Li	171	92.4
	Miao	10	5.4
	Han	4	2.2
4. Level of education	No formal education	27	14.6
	Primary school	69	37.3
	Middle school	68	36.8
	High school and above	19	10.3
	NA (incomplete)	2	1.1
5. Village location	Bawang	34	18.4
	Qingsong	124	67.0
	Wangxia	27	14.6

Table 4.2 Binomial generalized linear model predictors and model outputs for questions about understanding of local wildlife decline and extinction, attitudes towards local human activities, and whether citizens or the government were thought to be responsible for conservation.

Response	R^2	Predictor	X^2	df	p-value
1. Perceive a decline in wildlife populations (n=169)	0.146	Age	11.748	1	0.001 ***
		Gender	0.974	1	0.324
		Location	8.814	2	0.012 *
		Education	5.782	3	0.123
2. Think extinction is possible (n=168)	0.160	Age	11.666	1	0.001 ***
		Gender	1.303	1	0.254
		Location	6.854	2	0.032 *
		Education	6.836	3	0.077
3. Could name at least one declined species (n= 167)	0.137	Age	7.403	1	0.007 **
		Gender	1.105	1	0.293
		Location	11.499	2	0.003 **
		Education	2.319	3	0.509
4. Could name at least one extinct species (n= 167)	0.145	Age	7.779	1	0.005 **
		Gender	1.249	1	0.264
		Location	11.888	2	0.003 **
		Education	4.221	3	0.239
5. Thought local human activities caused wildlife extinction (n=164)	0.105	Age	1.847	1	0.174
		Gender	0.322	1	0.570
		Location	1.059	2	0.589
		Education	14.057	3	0.003 **
		Think extinction is possible	3.152	1	0.076
6. Thought local human activities caused wildlife decline (n=164)	0.156	Age	0.120	1	0.729
		Gender	2.757	1	0.097
		Location	14.460	2	0.001 ***
		Education	7.402	3	0.060
		Think extinction is possible	3.625	1	0.057
7. Thought it's acceptable to use natural resources from the forest (n=166)	0.086	Age	0.767	1	0.381
		Gender	0.443	1	0.506
		Location	6.980	2	0.031 *
		Education	1.348	3	0.718
		Think extinction is possible	5.310	1	0.021 *
8. Thought citizens are responsible for conservation (n=162)	0.225	Age	6.423	1	0.011 *
		Gender	0.058	1	0.810
		Location	5.628	2	0.060
		Education	24.638	3	1.838e-05 ***

			Think extinction is possible	2.667	1	0.102
9.	Thought government authorities are responsible for conservation (n=165)	0.110	Age	12.351	1	0.0004 ***
			Gender	0.034	1	0.853
			Location	0.448	2	0.799
			Education	6.089	3	0.107
			Think extinction is possible	0.088	1	0.766

Table 4.3 For binomial generalized linear models in which village location and education level were significant predictors, Tukey post-hoc pairwise comparisons are shown for differences between levels.

Response	Predictor	Estimate	Standard error	z-value	p-value
1. Perceive a decline in wildlife populations (n=169)	Area, Qingsong vs Bawang	1.333	0.522	2.554	0.028 *
	Location, Wangxia vs Bawang	1.461	0.632	2.310	0.053
	Location, Wangxia vs Qingsong	0.129	0.472	0.273	0.959
2. Think extinction is possible (n=168)	Location, Qingsong v Bawang	0.934	0.523	1.784	0.170
	Location, Wangxia -vs Bawang	-0.285	0.734	-0.388	0.919
	Location, Wangxia v Qingsong	-1.219	0.606	-2.011	0.106
3. Could name at least one declined species (n= 167)	Location, Qingsong v Bawang	1.367	0.491	2.785	0.015 *
	Location, Wangxia -vs Bawang	0.686	0.611	1.124	0.494
	Location, Wangxia v Qingsong	-0.681	0.477	-1.428	0.321
4. Could name at least one extinct species (n= 167)	Location, Qingsong v Bawang	1.819	1.819	2.760	0.015 *
	Location, Wangxia -vs Bawang	1.556	0.761	2.046	0.098
	Location, Wangxia v Qingsong	-0.263	0.495	-0.532	0.852
5. Thought local human activities	Education, middle vs high	0.0393	0.637	0.062	1.000
	Education, none vs high	-17.587	1383.419	-0.013	1.000

	caused wildlife extinction (n=164)	Education, primary vs high	-0.602	0.666	-0.904	0.767
		Education, none vs middle	-17.627	1383.419	-0.013	1.000
		Education, primary vs middle	-0.642	0.442	-1.452	0.410
		Education, primary vs none	16.985	1383.419	0.012	1.000
6.	Thought local human activities caused wildlife decline (n=164)	Location, Qingsong vs Bawang	1.615	0.60162	2.684	0.019 *
		Location, Wangxia vs Qingsong	-0.5201	0.52	-1.001	0.570
		Location, Wangxia vs Bawang	1.094	0.7178	1.524	0.274
7.	Thought it's acceptable to use natural resources from the forest (n=166)	Location, Wangxia vs Bawang	1.455	0.5775	2.519	0.031 *
		Location, Qingsong vs Bawang	0.778	0.464	1.675	0.212
		Location, Wangxia vs Qingsong	0.677	0.475	1.423	0.325
8.	Thought citizens are responsible for conservation (n=162)	Education, middle vs high	-0.621	0.602	-1.031	0.713
		Education, none vs high	-3.525	1.187	-2.968	0.014 *
		Education, primary vs high	-1.740	0.627	-2.774	0.024 *
		Education, none vs middle	-2.904	1.078	-2.693	0.031 *
		Education, primary vs middle	-1.119	0.417	-2.682	0.032 *
		Education, primary vs none	1.785	1.086	1.644	0.331

Figure 4.6 Attitudes of interviewees towards collecting firewood for household fuel, using forest resources, and hunting (n = 182).

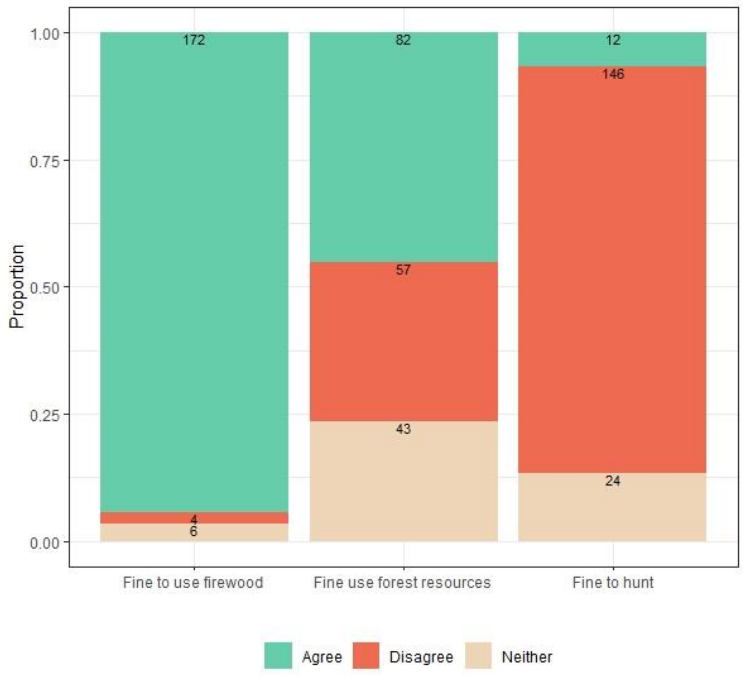
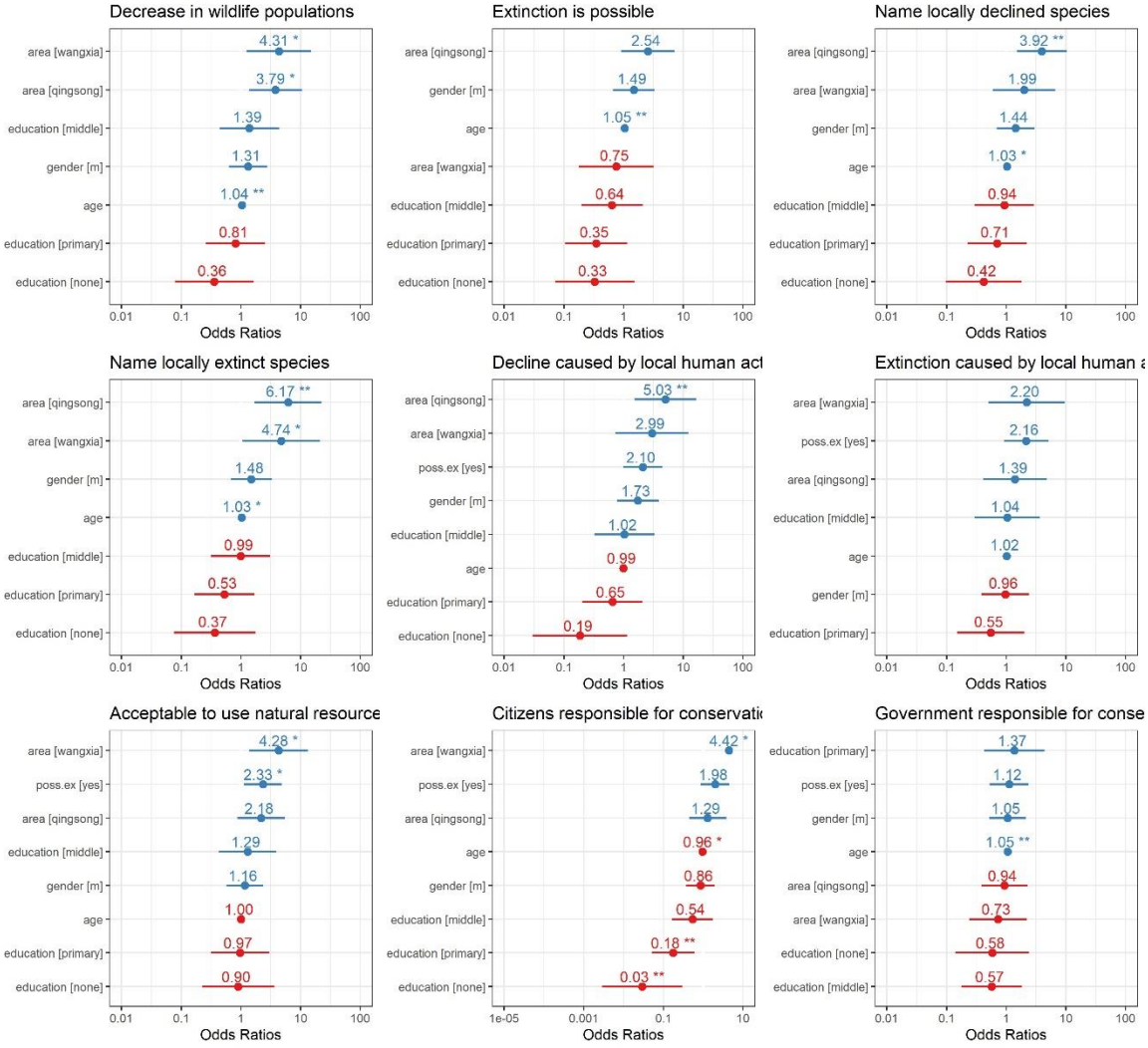


Figure 4.7 Odds ratios of significant predictors in binomial generalized linear models. Each of the two village areas was compared to Bawang area, and each of the three education levels was compared to high education level (high school and above).



CHAPTER 5

Ecological knowledge of traded species and its relationship with value: Local perceptions of native turtles in Hainan, China

ABSTRACT

Wildlife trade is driving species extinctions globally, with some taxa disproportionately more threatened than others. An important example is the Asian Turtle Crisis, which is endangering native species in China as rare species continue to be collected from the wild by non-professional hunters and sold at high prices. Gaps in the wildlife trade literature remain where baselines of local perceptions are lacking, especially whether various indices of local ecological knowledge are related to the market values of traded species. To assess whether local people's awareness of potentially traded turtles might indicate direct interaction with trade in the species, we conducted 185 interviews in rural villages around Bawangling National Nature Reserve (BNNR) in Hainan, China. Interviewees were asked to free list native turtles to determine species salience, then were shown photographs of the species to quantify awareness. We investigated whether there are relationships between species' salience, being recognized, named, perceived to be traded by more people, and independently obtained market prices. Indices of species awareness varied among local people, but all species were reported to be traded by at least some people. There was no correlation between indices of awareness and market value, indicating that more valuable species were no more likely to be well known. However, the perception that turtles are traded irrespective of species is a concern for conservation because all species are then vulnerable to exploitation. Local perceptions should be routinely integrated in wildlife trade research, and are best interpreted with other sources of evidence, such as from biological surveys and monitoring markets.

KEY WORDS

Local community, ecological knowledge, perceptions, testudines, *Cuora trifasciata*, *Platysternon megacephalum*, human-wildlife interactions

INTRODUCTION

Wildlife trade, both legal and illegal, affects species across the tree of life, fuels a global multibillion-dollar market and is a major cause of biodiversity loss (Bennett et al., 2002; Scheffers et al., 2020). The purposes of wildlife trade are highly diverse, ranging from subsistence-based consumption to highly lucrative enterprises involving organized crime (Rosen & Smith, 2010; Esmail et al., 2020). Unsustainable hunting for consumption and trade has resulted in widespread defaunation, especially in biodiverse tropical regions (Harrison, 2011; Benítez-López et al., 2017). Trade is influenced by various factors, including awareness, knowledge, and the perceived values and cultural significance of wildlife species, but current evidence on these relationships is often insufficient for effective mitigation (Challender et al., 2015; Thomas-Walters et al., 2020). The demand for certain species in trade is related to perceptions of their rarity, popularity, and as social status symbols, exemplified by the demand for exotic bird plumages for fashion in the 18th-19th centuries and the craze for "shatoosh" wool from Tibetan antelope in the 1990s (Doughty 1975, Schaller 2012). Monitoring the market is key to understanding what species are traded, where, how much, and by whom. However, gaps remain in developing robust ways to monitor the extent of trade, especially of lesser-known species, instead of only focusing on charismatic megafauna (t'Sas-Rofles et al., 2019).

Although environmental perceptions and natural resource management are known to be interrelated and influence each other (Bennett 2016; Pyhala et al., 2016), there is little research in directly assessing patterns of knowledge with characteristics of trade—whether there is a relationship between greater local awareness of species and their value in wildlife trade. Comparing knowledge of high-value traded species with that of lower-value species could offer important insights for conservation. For instance, in the absence of robust information on the extent of interaction between local peoples and wildlife, if there is a relationship between the awareness of a species and the level of trade, an assessment of awareness could then serve as a proxy for gauging local levels of trade in targeted species. For example, expert fishermen familiar with sea turtles demonstrated high recognition of the hawksbill turtle (*Eretmochelys imbricata*) compared to other species, which was partially attributed to the hawksbill's economic and cultural value (Braga and Schiavetti 2013). Additionally, Wang et al.'s (2021) comparison of local ecological knowledge of the Chinese pangolin (*Manis pentadactyla*) and Hainan peacock pheasant (*Polyplectron katsumatae*) suggested that more knowledge of the pangolin was likely due to intense trade and high prices of the species in recent history, even though peacock pheasants were also hunted but more likely to have been for personal consumption instead (Wang

et al., 2021). However, the relationship between species recognition and economic value was not directly evaluated in these studies.

Furthermore, local knowledge can also contribute key information for which conventional market and consumer surveys alone are inadequate because of the clandestine nature of such activity and trade networks (Wong 2019; Esmail et al., 2020). Both legal and illegal wildlife trade is difficult to quantify, limited by the ability of researchers to gather data systematically. The supply chain of wildlife trade often originates among local communities living near natural habitats of the exploited species, and there is increasing emphasis on reducing hunting pressure at the community-level (Biggs et al., 2017; Cooney et al., 2017). In particular, the wildlife trade literature points to a need for more active engagement of local communities in reducing hunting pressures (Roe and Booker, 2018), which can begin with exploring how local understanding of trade might be reflected in ecological knowledge. For example, local fishers' knowledge of threatened turtles has provided valuable information about the threats facing species and helps identify conservation opportunities (Braga & Schiavetti, 2013; Early-Capistrán et al., 2020; Pham et al., 2020). Additionally, ecological knowledge of fishers revealed conservation potential such as cultural importance of marine species and willingness to reduce bycatch (Butler et al., 2012, Braga and Schiavetti 2013). Therefore, there is more potential for an understanding of local perceptions to contribute to wildlife trade research and management.

Various demographic and sociocultural factors are known to affect ecological knowledge. For example, experiential knowledge accumulated over time can be higher in older people (Beaudreau and Levin, 2016; Kai et al., 2014), and can also be eroded when such knowledge is not passed down to younger generations (Papworth et al., 2009; Turvey et al., 2010). Additionally, gender has been found to affect ecological knowledge and awareness of the local environment (Kai et al., 2014; Nyhus et al., 2003), possibly due to differing societal roles and division of labor between men and women. Knowledge can also be affected by education level, although while more schooling is known to increase knowledge and cognitive abilities, in some cases it may instead erode local ecological knowledge (Reyes-García et al., 2010). Ecological knowledge loss has been further associated with rapid industrialization and urbanization (Pilgirim et al., 2007). Nonetheless, knowledge of trade could also be positively influenced by connectivity to urban areas, where there is access to markets, as distance to the nearest town has been found to be inversely related to hunting pressure on wildlife (Benitez-Lopez et al. 2017). Therefore, considering the influence of these context-dependent factors would result in a more comprehensive understanding of local knowledge of traded wildlife.

Globally, reptiles are severely threatened by human activity, but are disproportionally lacking in data compared to mammals and birds (Bland & Böhm, 2016; Gumbs et al., 2020). Specifically, the Asian Turtle Crisis, or the extirpation of turtles by hunting, trade, and habitat destruction, is the main challenge to turtle conservation globally, with half of all chelonian species threatened with extinction (van Dijk et al., 2000; Cheung & Dudgeon, 2006; Rhodin et al., 2018; Stanford et al., 2020). In China, it has long been recognized that wildlife demand and consumption is a major challenge to conservation (Zhang et al., 2008; Zhang & Yin, 2014). China has a high native turtle diversity that is also heavily exploited (Gong et al., 2006; Shi et al., 2007; Gong et al., 2017), and turtles and turtle products have traditionally been used for food, medicine, decoration, and pets (Cheung & Dudgeon, 2006, Ge 2016). This demand has led to widespread trade of both wild-caught and captive-bred turtles, driving wild populations of turtles in China to the brink of extinction while also affecting species trafficked from elsewhere (Shi et al., 2013; Wu et al., 2020).

However, baseline evidence on the awareness of turtle species among suppliers and consumers in China, and the relative monetary values of these species, remains difficult to obtain (Shi et al., 2013; Gaillard et al., 2017; Sung & Fong, 2018; Ye et al., 2020). In southern China, recent research at the local community level has revealed high variation in local peoples' awareness of turtles, collecting behaviors, and market prices (Wan et al., 2015; Gaillard et al., 2017), and highlights the need for more comprehensive research on how local knowledge can be applied to understanding trade. Unfortunately, both unsustainable trade and knowledge gaps identified several decades ago about the impacts of trade and conservation status remain for overexploited turtles (van Dijk et al., 2000; Lau and Shi 2000; Shi et al., 2013; Stanford et al., 2020). Specifically, little is known about local knowledge and awareness of turtle trade, especially near and inside nature reserves (Wan et al., 2015; Gaillard et al., 2017; Gong et al., 2017), and how it relates to the values of species in trade (Sung and Fong 2018, Ye et al., 2020).

In this study, we evaluated whether species with higher market values are better known to local people living near Bawangling National Nature Reserve (BNNR), by investigating the relationship between various indices of awareness of different species, and comparing the relative ranks of local awareness with relative market values obtained independently by researchers familiar with the trade. We quantitatively assessed which of the ten native Hainanese terrestrial and freshwater turtle species are most salient, most identified from photographs, most named by their common Chinese name, and most reported to be traded by local people, and then explored how knowledge and perceptions of trade vary among local people while controlling for

demographic and behavioral characteristics. By identifying patterns in local perceptions, our results evaluate the possibility of using ecological knowledge as a proxy for monitoring the perceived value of traded species and provide new insights for improving Hainan's turtle conservation. Furthermore, these findings contribute to tackling unsustainable wildlife trade by demonstrating the value of incorporating local perceptions and ecological knowledge into conservation baselines for data-poor taxa and regions.

METHODS

4. Study site

Interviews were conducted in rural village communities within three kilometers of the boundary of BNNR, in western Hainan Province, China (**Figure 5.1**). BNNR (18°57-19°11 N, 109°03-109°17 E) is a national-level nature reserve with an area of 300 km². Established in 1980 and promoted to national level in 1988, it is the habitat of the sole population of the world's rarest primate, the Critically Endangered Hainan gibbon (*Nomascus hainanus*) (Geissman and Bleisch, 2020; Liu et al., 2020). The reserve contains some of Hainan's last remaining mature tropical forest, but fragmentation is severe (Zhang et al., 2010). Other than gibbon monitoring, formal scientific research on the reserve's biodiversity, including the distribution, population trends, and threats to locally-occurring species, is minimal (Fellowes et al., 2001; Chan et al., 2005). In and around other nature reserves in Hainan, while extensive field surveys focusing on the big-headed turtle (*Platysternon megacephalum*) have been conducted in recent years (Xiao et al., in press), surveys of other turtle species are limited (Gaillard et al., 2017). Hunting and trapping of wildlife continue to occur in Hainan's forests, including poaching inside nature reserves (Gong et al., 2017; Wang et al., 2021; Xu et al., 2017). Local people are mainly of Li ethnicity, are relatively impoverished, and rely primarily on agriculture for their livelihoods (Davies & Wismer, 2013), but some Miao and Han people also reside in the area. Villages tightly surround the reserve, with some located less than one kilometer from the reserve boundary (**Figure 5.1**).

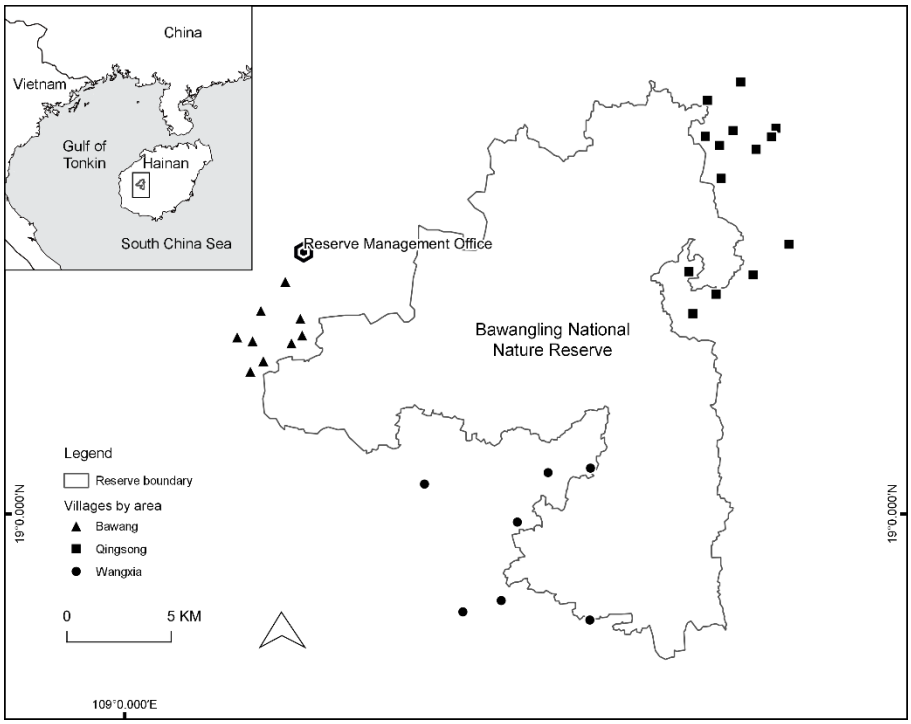


Figure 5.1. Villages visited in this survey adjacent to BNNR in western Hainan, China. Villages located in three main areas are distinguished by different symbols.

5. Data collection

Data were collected between February 27th and April 1st, 2019. The team consisted of one PhD student and four undergraduate students from a local university. All 30 villages within 3 km of the boundary of BNNR were surveyed. Villages naturally cluster in three areas (Bawang/Qicha town, Qingsong, and Wangxia), with clusters sharing village-level government, road access, bus routes and stops, and small shops (**Figure 5.1**). Individual household interviews were conducted by walking through the village and asking local people door-to-door. A target number of ten interviews (Guest et al., 2006) was set for each village but was only achieved in three villages; between two and ten people were interviewed across all villages, because in smaller villages, few people were available or willing to be interviewed. Interviewees participated voluntarily, and gave their free, prior and informed consent verbally instead of in writing due to low levels of literacy. Interviewees were informed that they could terminate or withdraw from the interview at any time for any reason and could choose to not answer any question. Support for this research was given by Hainan University College of Forestry, and ethics approval was obtained from Royal Holloway University of London's Research Ethics Committee (ID 535). These interviews

formed part of a more extensive interview survey which included additional questions and produced another set of data that was analyzed separately (Chapter 4).

Information was first collected on interviewees' demographic characteristics, including gender, age, numbers of years lived in the village, ethnicity, highest education level, and the frequency of visits per month to the forest and nearest county-level town. Interviewees were then asked to free list the common names of any turtles that they knew were found locally around BNNR (Newing, 2011). Names given were recorded in the order of listing. Finally, for a set of eleven turtle species, interviewees were shown two photos of each species and asked a series of questions including whether they recognized the species, if they knew its name, and if they thought the species is traded. The names of these species were not provided. All ten native terrestrial and freshwater turtles found in Hainan were included (list of turtle species in **Supporting information Table 5.5;** questionnaire in **Appendices, Questionnaire 3**). Additionally, a negative control species that is only found in eastern North America, the spotted turtle (*Clemmys guttata*), was included to screen for interviewees whose answers may be unreliable. Sea turtles were excluded because interviews took place in rural isolated villages in the mountainous interior of Hainan, where it is not possible for residents to have seen a wild sea turtle locally in their village. Species were shown in random order, but this order was kept consistent for all interviews.

Information on the market price of each species was not asked in the interviews to avoid suggesting that wild turtles are traded or have economic value to people who do not already know about it, which could risk stimulating trade where there previously was none. Instead, price information was recorded when voluntarily given by interviewees in open-ended questions and during discussions. When more than one interviewee provided a price for a species, the mean price and range were calculated.

Estimated market prices of native Hainanese turtles were provided by researchers at Hainan Normal University, based on data gathered through contacts at turtle captive breeding facilities, online trade networks, and market surveys (Gaillard et al., 2017; D. Gaillard and F. Xiao, *pers comm.* 2020), and representing the most reliable and recent prices. Due to the uncertainty of market prices, additional available information from published literature was also consulted (Wan et al., 2005; Gong et al., 2006; Sung and Fong 2018).

6. Data analysis

There are various local names for the ten native Hainanese turtle species, so free listing data were first processed to reduce as much ambiguity as possible. Criteria for linking Chinese local names

of turtles and their possible variations with scientific names were based on the Identification Manual for Traded Turtles in China (Shi et al., 2013) and information provided by knowledgeable turtle researchers at Hainan Normal University, who have conducted extensive village visits and interviews with local people and traders across Hainan (**Supporting information Table 5.5**; D. Gaillard and F. Xiao, *pers comm.*, 2017-2020). For all analyses, respondents who claimed they knew the negative control (n = 10) were excluded. Names that were ambiguous or did not meaningfully indicate a specific species (i.e. 'turtle', 'small turtle', 'cheap turtle', 'river turtle', 'tree turtle', 'small headed turtle'; n = 15) were not included in analyses. One mention each of sea turtle and common snapping turtle (*Chelydra serpentina*) were also excluded because these are not species that could be found locally in the wild.

Statistical analyses were performed in R version 3.5.2 (R Core Team 2018). Salience of the ten native Hainanese turtle species was derived from the free listed names by calculating Smith's Scores in the R package AnthroTools (Purzycki and Jamieson-Lane, 2017), which is based on both the frequency and order of each species mentioned by interviewees. To quantify and compare which species was the most frequently free listed, recognized from photographs, named, and reported to be traded, proportions of responses for each of these attributes were calculated because different numbers of people answered each question. Proportions of people who named a species and reported that it is traded were calculated from only the number of people who recognized the species from photographs, since people who did not recognize the species were not asked any additional questions. Species' relative trade values were ranked by the estimated prices of wild-caught rather than captive-bred individuals, since turtles sold from the villages would be collected in the wild.

Spearman's rank correlation tests were performed on all combinations between the ranks of species salience and the ranks of proportions of interviewees recognizing, naming, thinking the species is traded, prices provided by interviewees, and prices provided by researchers. A Bonferroni correction was applied to adjust the p-values for multiple testing.

Negative binomial count generalized linear models (GLMs) were used to determine which sociodemographic variables were associated with the number of turtle species that interviewees were able to recognize, name, and thought were traded. Only interviewees of Li ethnicity were included in the GLMs to control for ethnicity; ethnicity was not included as a predictor in the models because there was too little variation in this demographic variable (92.40% of interviewees were of Li ethnicity). The total number of species each interviewee recognized, named, and thought were traded were summed and analyzed as integers between 1-10; only

interviewees who knew at least one species were included. A full model approach was taken because demographic variables were selected based on their potential impacts on the response variable as identified in the literature, to avoid favoring significant results and Type I errors (Forstmeier and Schielzeth, 2011; Kerr 1998), and also because the model is not intended to make global predictions but rather to detect relationships between the pre-hypothesized predictors and responses. For example, Papworth et al. (2019) and Curtin and Papworth (2018) used full models to investigate relationships between individuals' demographic variables and responses to conservation issues. Model predictors included: 1) age, 2) gender, 3) village location, 4) highest level of education, 5) going into the forest at least once a month, 6) going to the nearest county town at least once a month, and 7) distance to the county town. Forest and town visits are binary (yes/1 and no/0). Distance to the nearest county town is a continuous variable measured in kilometers of road distance on Google Maps. All other predictor variables are categorical. Age and the number of years lived in the village were correlated (Pearson's correlation test, coefficient = 0.83; $t = 20.15$, $df = 182$, $p < 0.0001$), thus only age was included as a predictor in the models.

RESULTS

1. Species salience, awareness and perceptions of trade

A total of 185 people were interviewed (see **Supporting Information Table 5.4** for demographic information). The majority of interviewees were of Li ethnicity (n = 171), while the rest were Miao (n = 10) and Han (n = 4). More than two-thirds of interviewees were male (n = 130). More people were interviewed in villages in Qingsong than in Bawang or Wangxia, where fewer people were encountered or were willing to participate. More than half of all interviewees had either not had formal education or were only educated to primary school level (n = 96). More than two-thirds of interviewees (n = 137) reported going to the forest at least once a month, but less than one-third reported visiting the nearest county town at least once a month (n = 56).

Local people's responses about Hainan's ten native turtle species varied between species and by the type of awareness and knowledge. In total (n = 175), over half of all interviewees (57.7%, n = 101) free listed at least one species, while 41.1 % (n = 72) did not free list any species. The species mentioned most frequently in free listing were golden coin turtle (*Cuora trifasciata*), big-headed turtle, and keeled box turtle (*Cuora mouhotii*), although none of the ten species were mentioned by more than half of all interviewees. Salience varied between turtle species (**Figure**

5.2). Golden coin turtle was the most salient with the highest Smith's Score, followed by big-headed turtle and four-eyed turtle (*Sacalia quadriocellata*). Three species were not free listed by anyone and therefore do not have a Smith's Score: wattle-necked softshell turtle (*Palea steindachneri*), Chinese golden thread turtle (*Mauremys sinensis*), and Indochinese box turtle (*Cuora galbinifrons*).

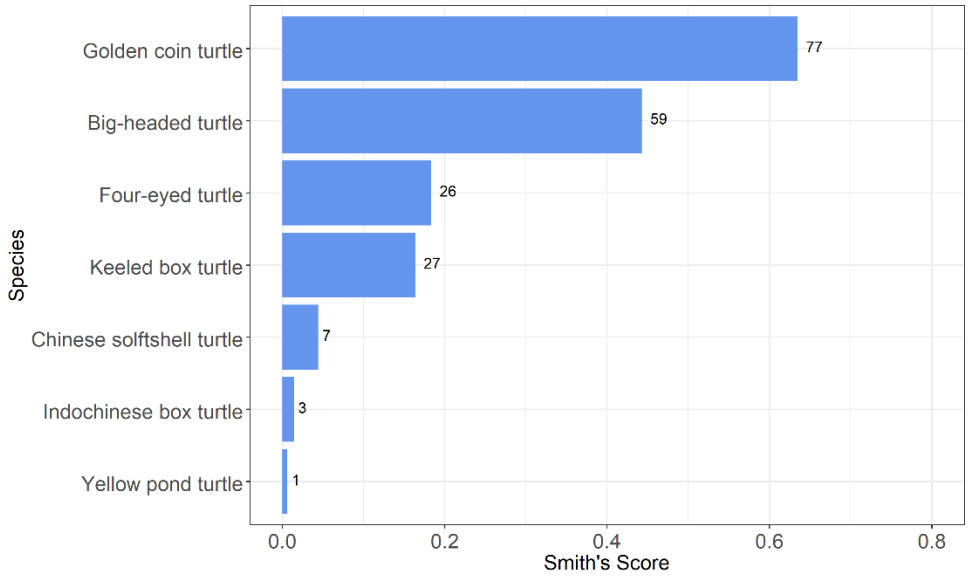


Figure 5.2. Smith's Score of salience of native Hainanese turtles calculated from free listing order and frequency (n = 101). Numbers on bars denote the numbers of respondents who mentioned each species.

When shown photographs of ten native Hainane turtle species, 78.9% (n = 138) reported recognizing at least one species, while 21.1% (n = 37) did not recognize any. Similar to free listing, none of the species were recognized by more than half of all interviewees. While all species were recognized by some people, half of the species were not named by anyone, and four were not mentioned in free listing by anyone (**Figure 5.3**).

Of the interviewees who recognized at least one species (n = 138), the three species most frequently named were big-headed turtle, golden coin turtle, and Chinese softshell turtle, with big-headed turtle and golden coin turtle named by over 90% of interviewees who recognized the photos of these species. Photographs of five species were not named by anyone: Indochinese box turtle, yellow pond turtle (*Mauremys mutica)*, wattle-necked softshell turtle, black-breasted leaf

turtle (*Geomyda spengleri)*, and Chinese golden thread turtle (*Mauremys sinensis*), despite all of them being recognized (**Figure 5.3**).

Of all interviewees, 53.1% (n = 93) reported at least one species to be traded, while 46.9% (n = 82) reported none of the ten species were traded. All ten species were reported to be traded by at least 25% of interviewees who could recognize the species, even though three species (wattle-necked softshell turtle, black-breasted leaf turtle, and Chinese golden thread turtle) were not free listed or named by anyone. Four species were reported to be traded by at least 50% of interviewees who recognized these species (**Figure 5.3**).

While proportionally the golden coin turtle was the most frequently free listed species, the total number of interviewees who did so was still low. Six species were more frequently recognized than they were free listed, including the Chinese softshell turtle, which was rarely free listed despite being relatively widely recognized and named. Similarly, the wattle-necked softshell turtle was also relatively widely recognized, but was not free listed or named by anyone. The reverse was true only for the golden coin turtle, which was more widely free listed than recognized (**Figure 5.3**).

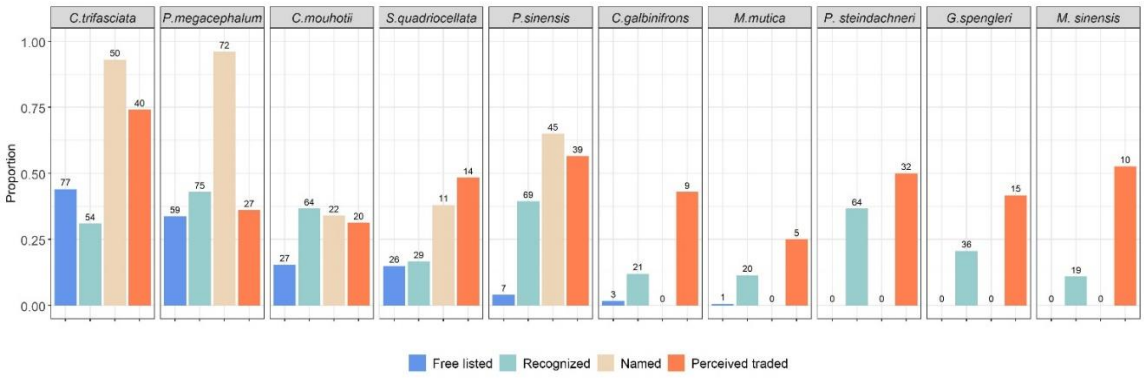


Figure 5.3. Interviewees' responses about ten native Hainanese turtle species when shown photographs of each species individually (n = 175). Proportions of recognizing species are calculated from the entire sample. Proportions of naming species and perceiving them to be traded are calculated from the number of interviewees who reportedly recognized each species respectively. Numbers on bars denote the numbers of interviewees who gave each response. Species are ordered by decreasing proportion of interviewees who free listed each species.

2. Rank correlations between indices of awareness and prices provided by interviewees and researchers

Market prices that were voluntarily reported by some interviewees reflect a wide range in perceived economic value between species (**Table 5.1**). Prices of turtles spanned a huge range, from the cheapest (four-eyed turtle) at 360 yuan/kg, to the golden coin turtle, which was five hundred times more expensive at 185,000 yuan/kg. The price of the golden coin turtle was mentioned by the most interviewees during discussions without being asked (n = 12). In comparison to the estimated market prices of wild-caught turtles obtained by Hainan Normal University's researchers, local people's perceived prices of black-breasted leaf turtle, yellow pond turtle, Chinese golden-thread turtle, big-headed turtle, and four-eyed turtle were underestimated, while prices of golden coin turtle, Indochinese box turtle, and Chinese softshell turtle were overestimated.

Table 5.1. Mean market price and range for native turtle species. Information was volunteered by interviewees, not asked as a standardized question; mean prices are shown where more than one estimate was provided. Numbers of interviewees who offered this information are indicated. Estimated most recent market price ranges (2020) for wild-caught individuals were provided by Hainan Normal University and ranked by decreasing median price. All prices are rounded to the nearest yuan per kg (1 GBP = c 8.8 CNY/yuan).

Scientific name	**English common name**	**Mean price reported by interviewees (yuan/kg)**	**Range (yuan/kg)**	**Number of people who offered this information**	**Range in price of wild-caught turtles estimated by researchers (yuan/kg)**	**Rank by decreasing price, based on median of researcher estimated price range**
Cuora galbinifrons	Indochinese Box Turtle	200,000	NA	1	1,400-4,000	5
Cuora mouhotii	Keeled Box Turtle	1,233	600-2,000	3	600-1000	8
Cuora trifasciata	Golden Coin Turtle	185,000	20-600,000	12	20,000-40,000	1
Geoemyda spengleri	Black-breasted Leaf Turtle	1,000	NA	1	1,000-3,200	6
Mauremys mutica	Yellow Pond Turtle	1,900	NA	1	2,400-5,000	4
Mauremys sinensis	Chinese Golden Thread Turtle	760	NA	1	4,000	3

Palea steindachneri	Wattle-necked Softshell Turtle	1,020	200- 1500	5	NA	NA
Pelodiscus sinensis	Chinese Softshell Turtle	920	200-2,000	5	200-600	9
Platysternon megacephalum	Big-Headed Turtle	1,060	400-2,000	5	1,600-10,000	2
Sacalia quadriocellata	Four-eyed Turtle	360	NA	1	800-2,400	7

The most expensive species based on researchers' knowledge of the market was also the species most reported to be traded (gold coin turtle, by 40 out of the 54 interviewees who recognized it). The cheapest species, the Chinese softshell turtle, was the second most reported to be traded (by 39 out of the 69 interviewees who recognized it). There was a significant correlation between a species' relative salience and likelihood of being named, but not between any other indices of awareness and independently obtained market prices (**Table 5.2**). There were no significant correlations between the ranks of all other attributes after the critical value (0.05) was adjusted to 0.003 by applying a Bonferroni correction.

3. Factors associated with number of species that were free listed, recognized, named, and reported as traded

Village location was a significant predictor for all four indices of turtle species awareness (**Table 5.3**). Models showed differences between village location, indicating people in Qingsong were more likely to know more species (recognize, name, and report being traded) when shown photographs, although differences between the three areas were not large enough to be detected in post-hoc tests for free listing (see **Supporting Information Table 5.6** for Tukey post-hoc test results). Gender was a significant predictor for the number of species recognized from photographs and named, with men knowing more species than women. Older people were more likely to recognize more species from photographs. Education level, frequency of visits to the forest and county town were not associated with awareness about more species for any indices.

Table 5.2. A, Spearman's rank correlation coefficients for all comparisons between the ranks of species salience, recognition, being named, being thought is traded, prices provided by interviewees, and prices provided by researchers (n = 9). **B,** p-values for all comparisons.

A.

	Salience	Recognize	Name	Trade	Price, local	Price, researcher
Salience	1					
Recognize	0.64	1				
Name	0.89	0.81	1			
Trade	0.23	0.03	0.32	1		
Price, local	0.27	0.07	0.03	-0.17	1	
Price, researcher	0.21	-0.18	0.16	0.10	0.43	1

B.

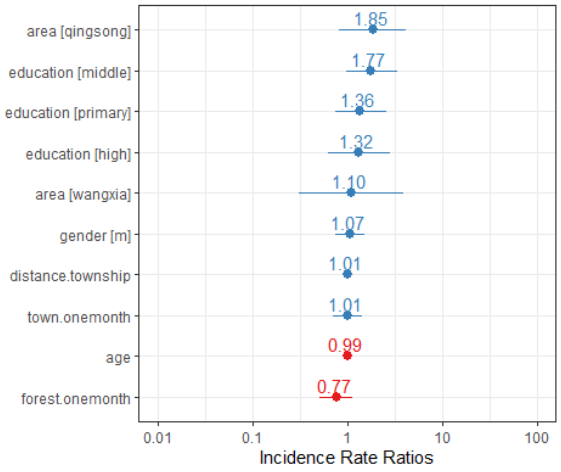
	Salience	Recognize	Name	Trade	Price, local	Price, researcher
Salience						
Recognize	0.0656					
Name	0.0012	0.0082				
Trade	0.5588	0.9322	0.3980			
Price, local	0.4860	0.8647	0.9468	0.6682		
Price, researcher	0.5890	0.6368	0.6873	0.7980	0.2440	

Table 5.3. Negative binomial generalized linear model predictors and model outputs for four indices of local people's perceptions of native turtle species.

Response	**R^2**	**Predictor**	**X^2**	**df**	**p-value**
10. Number of species free listed (n = 151)	0.131	Age	0.325	1	0.569
		Gender	0.462	1	0.497
		Village location	11.317	2	0.003 **
		Education	4.811	3	0.186
		Distance to county town	0.182	1	0.670
		County town visit ≥ once/month	0.014	1	0.907
		Forest visit ≥ once/month	1.643	1	0.200
11. Number of species recognized from photos (n = 151)	0.221	Age	8.845	1	0.003 **
		Gender	5.763	1	0.016 *
		Village location	14.554	2	0.001 ***
		Education	7.802	3	0.050
		Distance to county town	0.303	1	0.582
		County town visit ≥ once/month	0.303	1	0.582
		Forest visit ≥ once/month	0.220	1	0.639
12. Number of species named (n = 151)	0.241	Age	0.553	1	0.457
		Gender	8.991	1	0.003 **
		Village location	23.864	2	< 0.001 ***
		Education	5.354	3	0.148

			Distance to county town	0.480	1	0.488
			County town visit ≥ once/month	0.262	1	0.609
			Forest visit ≥ once/month	1.684	1	0.194
13.	Number of species reported to be traded (n = 151)	0.131	Age	0.325	1	0.569
			Gender	0.462	1	0.497
			Village location	11.317	2	0.003 **
			Education	4.811	3	0.186
			Distance to county town	0.182	1	0.670
			County town visit ≥ once/month	0.014	1	0.907
			Forest visit ≥ once/month	1.643	1	0.200

A



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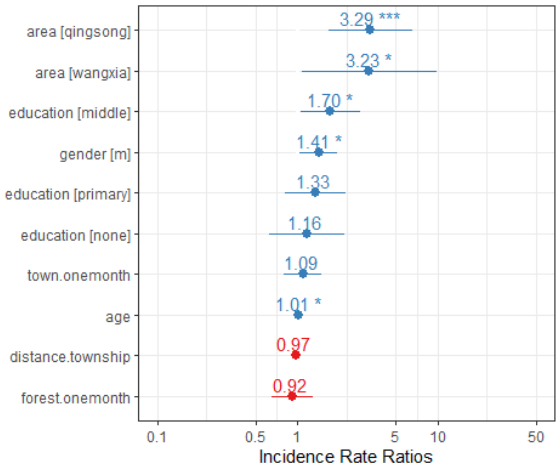

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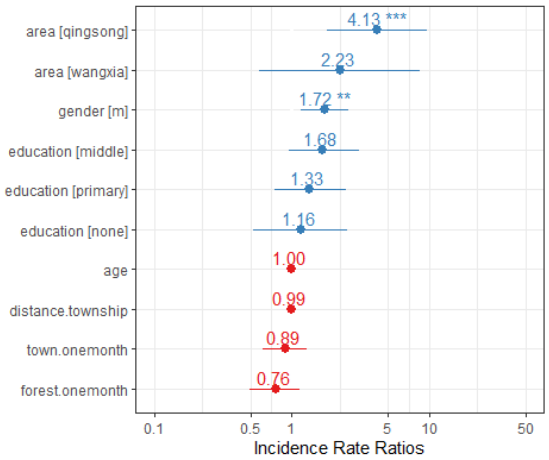

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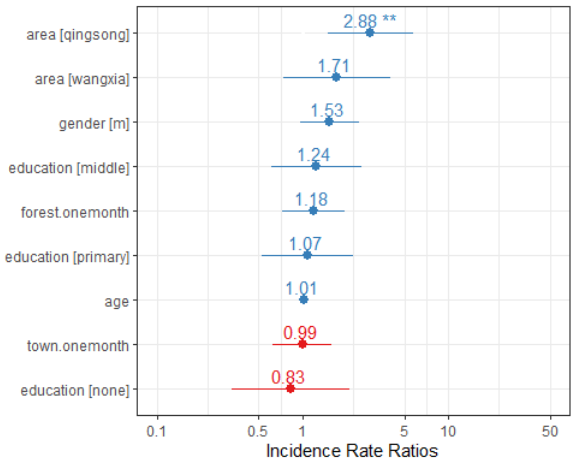

Figure 5.4. Incidence rate ratios of each GLM for four indices of local people's perceptions of native turtle species (n = 151 for all models): **A)** free listing more species; **B)** recognizing more species from photographs; **C)** naming more species; and **D)** reporting more species are traded.

DISCUSSION

Conservation is falling short for many taxa severely threatened by hunting and trade, and this problem is exacerbated by a lack of evidence of the human dimensions of this global concern (t'Sas-Rofles et al., 2019; Marshall et al., 2020). The Asian Turtle Crisis is an important case in point (Cheung and Dudgeon, 2006). Current knowledge of wildlife trade relies primarily on market surveys, online searches and seizure data, which do not capture local-level patterns of trade or perceptions of traded species in communities living in regions where wildlife is often collected supplied into the trade network (Challender et al., 2015; Phelps et al., 2016; Rosen & Smith, 2010). To address gaps in the understanding of awareness of such conservation-priority species and its relationship with trade, we investigated patterns of local knowledge of Hainan's native turtles, which are severely threatened by trade. Through surveying communities next to a protected area where illegal trade of native turtles occurs, we found some species were much more salient and well recognized than others and that awareness of more species was associated with age, gender, and living in a certain area. However, our analyses detected no relationship between the relative levels of awareness and market values of native turtle species. The lack of overall association between indices of awareness and market values of species suggests that local people do not have greater knowledge of more valuable species in the trade, but evaluating knowledge is nonetheless informative for indirectly measuring whether turtle collecting activities may be occurring.

Around BNNR, local awareness varied between the ten native turtle species, as well as between the four indices of awareness. Some species, such as the golden coin turtle, big-headed turtle and Chinese softshell turtle, were considerably better known, with more people free listing and knowing their names from photographs. Half of the species were poorly known and were not named by anyone, and of these, three species were also not free listed by anyone. However, all species were reported to be traded by at least some interviewees, irrespective of other indices of species-level awareness. The perception of trade affecting all species may suggest that turtles are considered by local people as a single ethnotaxonomic category rather than a group of diverse species, which is problematic for reducing harvest and increasing conservation concern. A

previous survey conducted in a neighboring county on Hainan showed a consensus among local people that native turtles have undergone declines from overexploitation, but 73% of interviewed collectors knew that trade was illegal and 91% did not think turtles should be protected (Gong et al., 2006). Illegal turtle harvesting, including from inside protected areas, is still occurring and protected area staff are often involved in poaching, suggesting that there is awareness of native turtle decline but little concern for it among local people (Gong et al., 2017). Low conservation awareness, when combined with the low ability to distinguish between species, could therefore exacerbate the crisis because threatened species could be accidentally traded even if they are not targeted. Because our findings indicate that turtle identification is difficult except for distinctive species, since many species were claimed to be recognized but were not named nor free listed, it is plausible that local people could unintentionally sell a turtle without knowing it is an endangered species, or be misled by traders that the turtle is either of high or low value.

Differences in species awareness also provide insights on the perceptions that local people have about turtles. Notably, the golden coin turtle was the most salient, and was free listed and reported to be traded by the highest proportion of people, although it was only the fifth most recognized. The high level of awareness of the golden coin turtle is unsurprising because it is widely known in China to be expensive, due to its huge popularity as a pet, food, and medicine (Shi 2006). Market prices for this species increased dramatically in the 1980s, likely stimulated by increased wealth and new markets created by China's economic reform, eventually leading to the collapse of wild populations in the 2000s (Shi 2006). However, to meet the demands of a lucrative market, golden coin turtles are farmed in large numbers (Shi 2007; Gong et al., 2018), which may explain why local people know about it even though they are unlikely to have seen a wild animal in recent years (Lau and Shi 2000; Shi 2006).

Varying awareness of other species can also be better understood by considering trade and captive breeding on a regional scale. The big-headed turtle has a conspicuous appearance with a large head, powerful beak, and aggressive biting behavior, which likely contributes to high overall awareness and recognition among local people (second after the golden coin turtle). Interestingly, despite its relatively common presence in pet markets in southern China, its high market prices, and reported incidences of international trafficking (Gong et al., 2017; ZSL, 2019; F. Xiao, *pers. comm.* 2021), a high proportion of interviewees did not report that it is traded. In contrast, confusion between other species is also possible. Interviewees were likely confusing wattle-necked softshell turtle with the Chinese softshell turtle, a species which is farmed, sold, and consumed in China in large numbers (Gong et al., 2018); a considerable number of people

claimed familiarity of both species based on photos, but no one free listed the wattled-necked softshell turtle. Prices given by interviewees for the two species were also very similar (appx. 1,000 yuan/kg). Interestingly, confusion in the identification of the near extinct Yangtze giant softshell turtles (*Rafetus swinhoei*) and the Chinese softshell turtle is also reported among local hunters in southern China, although Vietnamese hunters seem to distinguish the two species well (Pham et al., 2020). Enforcement of illegal trade could therefore also be hindered by this apparent lack of accurate species identification, making deception feasible by both intentional and accidental mislabelling of wildlife products (Giovos et al., 2020).

Our findings show that local awareness data have limitations due to potential ambiguity in local species names, which are known to vary between geographic areas, such as provinces within southern China (D. Gaillard, *pers comm.*). Such ambiguities are also common in local historical records of wildlife, in which multiple names may exist for the same species, or given names provide insufficient distinction between taxonomic groups (Turvey et al., 2019). To better understand local perceptions of wildlife and detect discrepancies between folk taxonomy and biological classification, interdisciplinary approaches should take to account of cultural and linguistic influences that may be unique to a study system. For example, studies in ethnotaxonomy of hunted species in Brazil and Ecuador found that wildlife could be classified by factors such as behavior and uses to humans as well as 'natural' taxonomy, which may in turn influence the species' cultural salience (Mourão et al., 2006; Souza & Begossi, 2007; Papworth et al., 2013). Ethnozoological approaches can therefore provide more insight into local conceptions of species diversity, and how they underpin human relationships with species such as hunting and trade. Without bridging the gap between different knowledge systems, mismatches between local understanding and formal scientific classification could potentially undermine conservation objectives.

We found differences in species awareness that further highlight the underlying heterogeneity in local perceptions even within a relatively small area. Village location was significantly associated with all indices of awareness, with people living in Qingsong having higher awareness. This difference is possibly due to Qingsong being more exposed to conservation in general because it is a base for gibbon monitoring, and some reserve wardens are from these villages. People in Qingsong were also found to have more awareness of species extinction (H. Ma, unpublished data, Chapter 4). Differences in knowledge between village location is also consistent with the apparent spatial and temporal variation for both local awareness and collecting activity of black-breasted leaf turtle detected by Gaillard et al. (2017). Such variation was reflected in the sudden

dramatic increases in collecting activities in some villages and counties but not others around and in Hainan's nature reserves (Gaillard et al., 2017). Therefore, potentially greater spatial variation in indices of turtle-related knowledge should be expected across wider landscapes, presenting additional challenges for extrapolating the extent and magnitude of trade at a larger scale. In contrast, this study found a lack of effect of age, education level, or access to town centers on species awareness. Age was only found to be a significant predictor of recognizing more species, consistent with previous studies in the same area which found that ecological knowledge is held more by older community members and has become eroded among younger people (Turvey et al., 2018, Qian et al., in press). The lack of effect of older age for all other indices of turtle awareness could be because knowledge about trade is more linked to access to connections and information external to the villages, so younger people might have more awareness than older people, especially with the prevalence of trade online.

Although there is a lack of correlation between awareness and relative market value, all turtle species were perceived by at least some people to be traded, suggesting that there is some awareness of the wider market. This may not be surprising because turtles are commonly consumed as food in China, and there is widespread farming of highly threatened turtles, which are caught from the wild by local people and sold to farmers (Shi et al., 2007). However, it cannot be inferred from this study that local people are familiar with the illegal trafficking of highly coveted species, especially those sold online or via middlemen on the black market. Due to the opaque nature of illegal wildlife trade, and the recent shift of substantial trade activity onto online platforms via private social media groups, specific information such as the price of particular species is becoming more difficult to obtain accurately (Esmail et al., 2020). Indeed, wildlife trade networks are complex and involve numerous pathways for information to transfer between different actors along the trade chain (Phelps et al., 2016). While local people may be knowledgeable about the ecology, behavior, and distribution of wildlife, unless they are directly involved in trading, they should not be assumed to be familiar with the market, as shown by the results of this study. Nonetheless, near several other protected areas in Hainan, the Chinese pangolin, its trade, and price were found to be well known among local communities indicating that for species intensely targeted for trade in the past, knowledge may be high irrespective of current levels of trade or individuals' direct engagement in trade (Wang et al., 2021).

This study responded to the need to engage with local communities in wildlife trade and contributed to the much-needed evidence base on local knowledge of traded species (Masse et al., 2020; Roe and Booker 2019; t'sas-Rofles et al., 2019). Specifically, our results contribute to new

understanding of local awareness of traded species and have conservation implications for heavily traded but poorly studied species. Considering the ambiguities in local people's identification of species, local knowledge alone may not be sufficient for detecting trading activities in the area. Knowledge could be reflective of other reasons for a species being well known, including high historical levels of demand and captive breeding. Even so, assessing local knowledge can indicate how the species are perceived by local people and provide useful information about potential threats and opportunities for mitigation, such as preventing the indiscriminate capture of all species in a taxonomic group, or raising awareness of the species protection status. Since questions about illegal wildlife trade can be sensitive and subject to biases in direct questioning (Nuno & St. John, 2014), measuring species awareness could yield valuable insights without interviewees risking admitting to hunting and trade. Doing so could also minimize both the risk to vulnerable interviewees and reduce the risk of exposing the location of highly sought-after rare species (Brittain et al., 2020; Meijaard & Nijman, 2014). We demonstrate that obtaining direct evidence of how different species' identities and trade are perceived among local communities can provide a starting point for evaluating the impacts of trade on wildlife, especially in areas with little prior research. Finally, local ecological knowledge can be more useful when interpreted and cross-validated with biological survey data (Turvey et al., 2007, 2018; Lin et al., 2019). Overall, we show nuanced insights that could be gained from assessing local knowledge of traded species, and highlight the importance of considering ethnotaxonomic systems when working with communities of different sociocultural backgrounds in conservation. These approaches are widely transferrable to other study contexts and would greatly aid the efforts to conserve species threatened by trade.

DATA AVAILABILITY

The datasets collected during this study are available from the corresponding author upon request. Data are not publicly available because they contain potential sensitive information on the interviewees' location, behavior, and personally opinions that may compromise their identities and safety. Research was approved by Royal Holloway University of London's Research Ethics Committee (ID 535).

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CONFLICT OF INTEREST

The authors declare no conflicts of interest.

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SUPPORTING INFORMATION

Table 5.4 Summary of demographic characteristics (predictors of GLMS) of all interview interviewees.

Demographic variables (n = 185)			
6. Age (years)	**Mean**	**Median**	**Range**
	44	45	19-78
7. Gender	**Categories**	**Number**	**Percentage**
	Female	55	29.7
	Male	130	70.2
8. Ethnicity	Li	171	92.4
	Miao	10	5.4
	Han	4	2.2
9. Level of education	No formal education	27	14.6
	Primary school	69	37.3
	Middle school	68	36.8
	High school and above	19	10.3
	NA (incomplete)	2	1.1
10. Village location	Bawang	34	18.4
	Qingsong	124	67.0
	Wangxia	27	14.6
11. Go to nearest county town at least once a month	Yes	56	30.3
	No	128	69.2
	NA	1	0.5
12. Go to forest at least once a month	Yes	137	74.1
	No	40	21.6
	NA	8	4.3
13. Distance from nearest county town (km)	**Mean**	**Median**	**Range**
	48.4	48.5	29.1-69.2

Table 5.5 Names of ten native Hainan freshwater and terrestrial turtle species and their conservation status and prioritization. Adapted from Shi et al. 2013 and F. Xiao, D. and Gaillard, *pers. comm*, 2017-2020.

Scientific name	Chinese name (s)	Other Chinese local names/variations	English common name	IUCN Red List	Chinese protection level	CITES	EDGE rank	EDGE score
Cuora galbinifrons	黄额闭壳龟，黄额盒龟，草龟，山草龟，红旗龟，假金钱龟	-	Indochinese box turtle	CR	Three merits	Appendix II	-	-
Cuora mouhotii	锯缘龟，八角龟	山龟， 坡龟	Keeled box turtle	EN	Three Merits	Appendix II	-	-
Cuora trifasciata	金钱龟	金子龟，金龟, 金乌龟	Golden coin turtle	CR	Class II	Appendix II	-	-
Geoemyda spengleri	锯齿地龟，小八角龟，枫叶龟		Black-breasted leaf turtle	EN	Class II	Appendix III	51	5.73
Mauremys mutica	材棺龟，石龟，黄喉泥水龟，南石龟，石金钱	石头龟	Asian yellow pond turtle	EN	Three merits	Appendix II	-	-
Mauremys sinensis	中华花龟，海花，海南花龟	-	Chinese golden thread turtle, Chinese striped-neck turtle	EN	Three merits	Appendix III	-	-
Palea steindachneri	疣颈龟，山瑞鳖	-	Wattle-necked softshell turtle	EN	Class II	Appendix III	63	5.7
Pelodiscus sinensis	中华鳖	甲鱼，鳖，水鱼, 王八	Chinese softshell turtle	VU	Not listed	Appendix III	-	-
Platysternon megacephalum	大头扁龟，硬嘴龟，平胸龟	大头龟	Big headed turtle	EN	Three merits	Appendix II	19	6.40
Sacalia quadriocellata	四眼斑龟，臭龟	水龟，水乌龟，牛屎龟	Four-eyed turtle	EN	Three merits	Appendix III	-	-

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Table 5.6 Tukey post-hoc test results are shown for differences between village areas. For all four generalized linear models, village area and was a significant predictor for the number of species free listed, recognized from photos, named, and thought to be traded.

Response	Comparison	Estimate	Standard error	z-value	p-value
1. Number of species free listed (n = 151)	Qingsong vs Bawang	0.61644	0.41123	1.499	0.243
	Wangxia vs Bawang	0.09191	0.65298	0.141	0.986
	Wangxia vs Qingsong	-0.52453	0.35145	-1.492	0.246
2. Number of species recognized from photos (n = 151)	Qingsong vs Bawang	1.19209	0.34559	3.449	0.00108 **
	Wangxia vs Bawang	1.17288	0.56337	2.082	0.07337 .
	Wangxia vs Qingsong	-0.01921	0.30433	-0.063	0.99713
3. Number of species named (n = 151)	Qingsong vs Bawang	1.4176	0.4272	3.318	0.0021 **
	Wangxia vs Bawang	0.8005	0.6823	1.173	0.4150
	Wangxia vs Qingsong	-0.6171	0.3842	-1.606	0.2045
4. Number of species thought to be traded (n = 150)	Qingsong vs Bawang	0.61644	0.41123	1.499	0.243
	Wangxia vs Bawang	0.09191	0.65298	0.141	0.986
	Wangxia vs Qingsong	-0.52453	0.35145	-1.492	0.246

CHAPTER 6

The medium over the message: Differential knowledge of conservation outreach activities and implications for threatened species

ABSTRACT

Conservation outreach is often conducted to increase support for conservation by altering local knowledge and attitudes about species or environmental issues. However, there is often little assessment of the effectiveness of these activities. We investigated knowledge of past conservation outreach in 26 villages adjacent to Bawangling National Nature Reserve, Hainan, China, which contains the last population of the Hainan gibbon (*Nomascus hainanus*). The medium of outreach activities and who delivered them were Reported by more people than the topic or messages being communicated. Negatively-framed messages, emphasizing prohibited activities and associated punishments, were reported better than positively-framed messages that aimed to foster conservation support. Male interviewees and those with higher education levels Reported more about past activities. The Hainan gibbon had higher salience than other threatened native species, and knowledge of the occurrence (but not necessarily the content) of past outreach was associated with increased likelihood of knowing that gibbons were threatened. These findings highlight the need for conservation outreach to increase retention of key messages among target audiences. Meaningful and concrete conservation benefits should be communicated to local people, and awareness-raising for conservation-priority species should also aim to benefit other species within the same landscapes.

KEY WORDS: China, conservation messaging, flagship species, *Nomascus hainanus*, interview survey, protected area

INTRODUCTION

Conservation outreach is increasingly used as a key tool for increasing conservation impacts, and has been adopted by major frameworks such as the Convention on Biological Diversity's Aichi Target 1 (Convention on Biological Diversity 2020). Priority activities include using communication, education, and public awareness (CEPA) to promote pro-environment attitudes and behavioral change among target audiences (Convention on Biological Diversity 2020). These activities aim to change people's knowledge, perceptions and attitudes about environmental conditions, governance, and conservation interventions (Rakotomamonjy et al., 2015; van der Ploeg et al., 2011). Increasing such awareness does not guarantee behavior change, and the pathway from awareness-raising to pro-conservation action involves complex social and psychological factors (Kidd et al., 2019; Schultz, 2011); however, awareness forms a foundation for engagement (Bennett et al., 2017; Bickford et al., 2012). An evidence-based approach is increasingly used in conservation (Bennett, 2016; Sutherland et al., 2004), but the effectiveness of outreach activities is still rarely evaluated, putting projects at risk of wasting resources (Kapos et al., 2008; Thomas et al., 2019). Specifically, context-specific evidence on the effectiveness of conservation interventions is often lacking, and is especially a problem in regions outside western developed countries and in non-English speaking regions where there are shortages of locally-relevant evidence available to conservation practitioners (Christie et al., 2020). Understanding how knowledge, perceptions and attitudes are influenced by outreach activities is thus important for better evaluation and ultimately increasing the success of such interventions (Thomas et al., 2019).

How messages are framed and delivered to target audiences, and how audiences receive and retain messages, are key components of outreach. Communication theory highlights the importance of how messages are transmitted, as the medium can influence what is communicated and received (McLuhan, 1964). Research in other domains that routinely employ outreach as a first step for behavioral change (e.g., public health interventions, political campaigns, social marketing) indicates that both medium and message can influence outcomes, in diverse ways (Guo & Moy, 1998; Low & Davenport, 2005; Randolph & Viswanath, 2004). For example, public health campaigns focusing on fear are more persuasive for behaviour change, but only when also emphasizing the efficacy of interventions (Witte & Allen, 2000), and fear-based messaging may also have unintended consequences for marginalizing vulnerable groups (Guttman & Salmon, 2004). In climate change messaging, framing the issue with either positive or negative terminology also affects intentions to engage in personal behaviour change

(Dickinson et al., 2013; Morton et al., 2011). Within conservation, messages are shown to be more effective when normative statements are used, when framed about benefits rather than losses, and when contextualized with global issues (Giannetta, 2018; Jacobson et al., 2019). When the medium overpowers the message, conservation outreach can also fall short of its intended goal. For example, audiences presented with online conservation campaigns endorsed by celebrities were less likely to recall messages than those presented by conservation professionals (Duthie et al., 2017); and positive attitudes towards wolf recovery in Europe are related to higher levels of trust in certain information sources (books, science-based media), with lower trust and more negative attitudes to press and television (Arbieu et al., 2019).

Outreach activities also require an understanding of what is important to target audiences, and why. Measuring salience (the relative prominence of items within a particular mental category) is widely used in anthropology, cultural studies and experimental psychology (Taylor & Fiske, 1978; Thompson & Juan, 2006), and can be used to monitor public awareness and understand how wildlife is perceived. For example, the online frequency of bird vernacular and scientific names has been used as an indicator of cultural salience, providing real-time trends of public interest (Correia et al., 2017; Ladle et al., 2016). Salience can be quantitatively measured through free-listing, which has been to used evaluate conservation education programs and understand the relative cultural importance of species (Nekaris et al., 2018; Papworth et al., 2013). However, the relationship between outreach activities, recall, and salience is influenced by various factors; salience reflects where attention is focused, and information-content, involvement, arousal, and individual differences can all be manipulated to affect what is remembered (Taylor & Fiske, 1978). Market research has further shown that emphasis on one subject can increase its salience while reducing that of others (Alba & Chattopadhyay, 1986; Jin et al., 2008). In addition, individual demographic characteristics and experiences, including education level, exposure to awareness-raising and education programs, and direct interaction with nature, can also influence knowledge, awareness and perceptions of conservation (Hooykaas et al., 2019; Howe et al., 2012; Nyhus et al., 2003). For example, age, gender, income, and learning opportunities and experiences are all associated with people's knowledge and perception of wildlife, protected areas, and threatened biodiversity (Allendorf & Yang, 2017; Li & Chen, 2018).

Human perceptions, awareness, and attitudes influence how people interact with species (Bickford et al., 2012; Nilsson et al., 2016), and increased awareness of highly publicized species might also influence interactions and values towards lesser-known threatened species (Bowen-Jones & Entwistle, 2002; Veríssimo et al., 2014). Assessment of which aspects of outreach

activities are most retained, and how these aspects relate to the salience of threatened species, is thus necessary to improve conservation communication. Key questions include what people report about such activities, and whether knowledge of these activities is associated with greater awareness of threatened species, within the context of variation in demographic characteristics and personal experiences. However, whereas much research and evaluation of conservation outreach has documented what messages were communicated and to whom, what is known and retained from outreach activities has rarely been evaluated (Kidd et al., 2019; Thomas et al., 2019).

To address this gap in conservation knowledge, we investigated how conservation outreach activities are reported, and how this relates to local perceptions about protected areas and threatened species, in communities surrounding Bawangling National Nature Reserve (BNNR), Hainan, China. Specifically, we evaluated which aspects of past conservation outreach activities were most reported by local people, which demographic variables affected this awareness, and whether knowledge of past conservation outreach could predict people's awareness and salience of local threatened species, including the reserve's conservation flagship species, the Hainan gibbon (*Nomascus hainanus*). Our findings have wider relevance for helping protected area managers and conservation organizations to identify appropriate messages to communicate with target audiences, and how to tailor these activities in local contexts with effective media to maximize retention and uptake.

METHODS

1. Study site

Bawangling National Nature Reserve (18°570-19°110 N, 109°030-109°170 E) is a protected area in Baisha and Changjiang counties, Hainan. It contains the only surviving population of the Critically Endangered Hainan gibbon, the world's rarest ape, which numbers around 30 individuals (Bryant, 2014; Chan et al., 2020). The reserve is surrounded by numerous small villages containing low-income, primarily agriculture-based communities, predominantly of Li or Miao ethnicities, with a long history of using natural resources from the nearby forest (Fauna and Flora International China Programme 2005; Davies & Wismer, 2013).

Various governmental and non-governmental bodies have conducted conservation outreach in these communities, focused on Hainan gibbon conservation (**Supporting Information 6.1**), but

the effectiveness of these activities has not been assessed. There are no systematic records of what outreach activities have been conducted, or by whom. However, reserve management officials report that conservation outreach is routinely conducted by reserve wardens and targets all villages surrounding the reserve (*pers. comm.* Qi Xuming, Hainan Provincial Forestry Bureau and BNNRMO, 2018), and additional community-based conservation outreach activities are also periodically conducted by non-governmental conservation organizations (Fauna and Flora International China Programme 2007, 2008; Kadoorie Farm and Botanic Garden 2016). All local communities have therefore been exposed to some outreach, although the activities, timing, aims, desired outcomes, and evaluation of these activities are not coordinated between stakeholders.

2. Data collection

Twenty-six villages were sampled from the total set of 30 villages situated within 3 kilometres of BNNR, including villages in both Baisha and Changjiang counties (**Figure 6.1**); not all 30 villages were sampled due to time and logistical constraints. Individual interviews were conducted in May–June 2018. Interviewees included both males and females aged 18 and above, and were selected opportunistically by walking through villages on foot and asking anyone encountered whether they were happy to be interviewed. A target sample of 10 interviews was conducted in each village.

A standardized questionnaire including open and closed questions, which took ~45 minutes to complete, was used for all one-to-one interviews (**Appendices, Questionnaire 2**). Free, prior, and informed verbal consent was obtained from all interviewees before interviews began, and interviewees were told they could discontinue at any point and choose not to answer any questions. Interviews were conducted in Mandarin by two of the authors (HM and JQ), although some older interviewees only spoke Li or Miao languages and family members helped with translation. Survey design was approved by Royal Holloway University of London's Research Ethics Committee (ID 535). Logistical support was provided by staff of the Hainan Forestry Bureau and Bawangling National Nature Reserve Management Office.

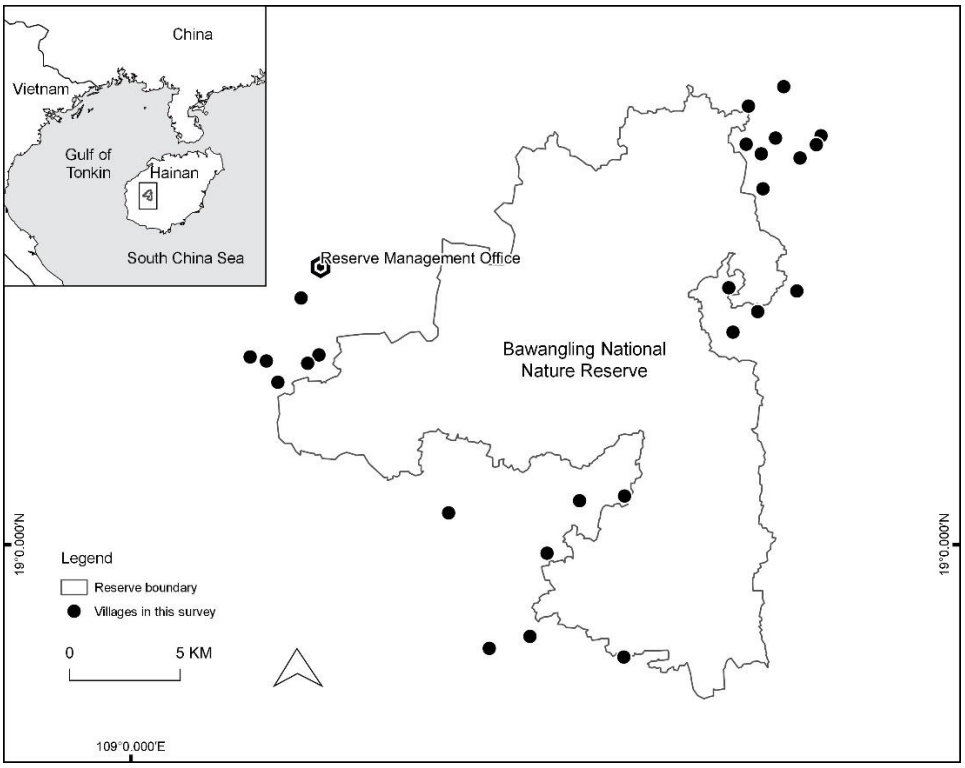

Figure 1. Locations of the 26 villages surveyed in this study around Bawangling National Nature Reserve, Hainan, China.

Demographic data were obtained first, including interviewee gender, age, ethnicity, highest level of education, annual household income, and whether they reported going into the forest more than once a month. Free-listing questions were then used to determine which wildlife species were perceived as threatened, first in China and then specifically in Hainan, with answers recorded in the order they were given to calculate salience. Finally, open-ended questions were asked about conservation conservation outreach activities that had occurred in the village. These questions included interviewee recollection of what content or information was communicated, who conducted the event, when the event took place, what medium of communication was used, what the interviewee thought the purpose of the event was, and what consequences there would be if they followed the reserve management policies they were told about. The term 'environmental conservation education activities' (*baohu xuanchuan jiaoyu huodong*) was used to avoid prompting interviewees specifically about wildlife conservation, and because this is the standard Chinese term for this type of activity. Hereafter, these activities are referred to as 'conservation outreach activities'. Additional survey data were also collected and have been published elsewhere (Qian et al., in press).

3. Data analysis

Data analysis was performed in R version 3.4.2 (R Core Team 2017). Generalized linear mixed effect models (GLMMs) with binomial error structures and logit link functions were conducted using the R package 'lme4'. A full-model approach rather than a model selection approach was then taken to investigate which individual demographic variables predicted interviewees' reporting of different aspects of conservation outreach activities, reporting of positively and negatively-framed messages, and awareness of threatened species to include all predictors identified in the literature that were expected to have an influence on the response variables and reducing potential bias by preferentially reporting significant results only (Forstmeier and Schielzeth, 2011; Kerr 1998). The analysis also does not intend to establish causality or make predictions but rather to detect relationships between the variables of interest. For example, the full model approach has been used by Papworth et al. (2019) and Curtin and Papworth (2018) to investigate relationships between respondent characteristics and conservation issues.

As systematic information on past outreach activities is not available, village was included as a random effect to control for possible variation in exposure to conservation outreach across communities around BNNR. Ethnicity was not included as a predictor in the models because there was little variation within this variable, with 91% (n=192) of interviewees of Li ethnicity; GLMMs were performed only using the subset of Li interviewees. Income was also not included as a predictor because 92% (n=195) of interviewees self-identified as either farmers or unemployed, but these terms were often used interchangeably because subsistence agriculture does not generate income, making it difficult to collect meaningful data for this question.

For GLMMs investigating which aspects of conservation outreach activities were reported, binary response variables included whether interviewees reported: (1) conservation outreach had occurred; (2) the medium of communication; (3) who conducted the conservation outreach; (4) the content; and (5) the consequences of following the reserve's conservation management policies. The reported content of conservation outreach messages was also grouped into two categories based on interviewees' perceptions of their impacts to local livelihoods and development: positively-framed messages associated with benefits to human wellbeing or environmental protection (e.g., conservation of wildlife, water and entire ecosystem; tourism development), and negatively-framed messages associated with regulations preventing certain activities or use of natural resources (e.g., not being allowed to hunt wildlife, set fires, cut down trees, or extract materials such as minerals, all of which local people were permitted to do before establishment of BNNR in 1980). Of the subset of interviewees who reported conservation

outreach content, two further GLMMs were conducted to test for demographic variables associated with the binary responses of (1) reporting positively-framed messages and (2) reporting negatively-framed messages. All GLMMs included the following predictor variables: age (continuous), gender (categorical), education level (categorical: none, primary school, middle school, high school and above), and frequency of forest visits (binary: at least once a month, or less than once a month).

Additional GLMMs were conducted for three binary response variables of interviewees' ability to free-list the following subjects: (1) perceived threatened species in China; (2) perceived threatened species in Hainan; (3) the Hainan gibbon as a threatened species in either China or Hainan. The same predictor variables were used for these analyses, plus whether interviewees reported conservation outreach activities having occurred at all (binary). The 'AnthroTools' package (Jamieson-Lane and Purzyki 2016) in R was used to calculate Smith's scores for quantifying the salience of free-listed species. A chi-squared test of independence was performed to test for association between interviewees who could name species in China and Hainan.

RESULTS

1. Knowledge of different aspects of conservation outreach activities

A total of 212 interviews were conducted, with a mean of eight interviews per village (**Supporting Information Table 6.2**). Some aspect of local conservation outreach was reported by 104 people (49.1%). Gender (binomial GLMM, n = 191, $\chi^2 = 11.354$, df = 1, p = 0.001) and education level (binomial GLMM, n = 191, $\chi^2 = 10.287$, df = 3, p = 0.016) significantly predicted whether interviewees could report outreach having occurred (for full results of all models see **Supporting Information Table 6.3 and Figure 6.5**). Men were more likely to report than women (odds ratio = 4.29, 95% CI = 1.84 – 10.00, p = 0.001), and interviewees with up to primary school level education were more likely to report than those with no schooling (Tukey post-hoc test, primary school vs no school, estimate = 1.717, standard error = 0.543, z-value = 3.164, p = 0.002).

The aspect of outreach activities that was reported by the greatest number of interviewees was the medium of communication (92/104), followed by who conducted them (84/104), and the message or content that was communicated (83/104). The fewest interviewees reported what the

consequences would be for following the reserve's conservation management policies (66/104) (**Figure 6.2**).

The most frequently reported medium of communication was group meetings (34/92), followed by messages broadcast from vehicles (29/92). Other identified media, reported by 45 interviewees, included people going door-to-door to speak with residents, showing posters or display boards, handing out leaflets with information, conveying information through the village head, opportunistic discussions in the village, showing films, and school activities. Gender (binomial GLMM, n = 191, $\chi^2 = 11.307$, df = 1, p = 0.001) and education level (binomial GLMM, n = 191, $\chi^2 = 8.635$, df = 3, p = 0.035) significantly predicted whether interviewees could report a specific medium. Men were more likely to report than women (odds ratio = 4.25, 95% CI = 1.83 – 9.88, p = 0.001), and interviewees with up to primary school level education were more likely to report than those with no schooling (Tukey post-hoc test, estimate = 1.376, standard error = 0.522, z-value = 2.636, p = 0.008).

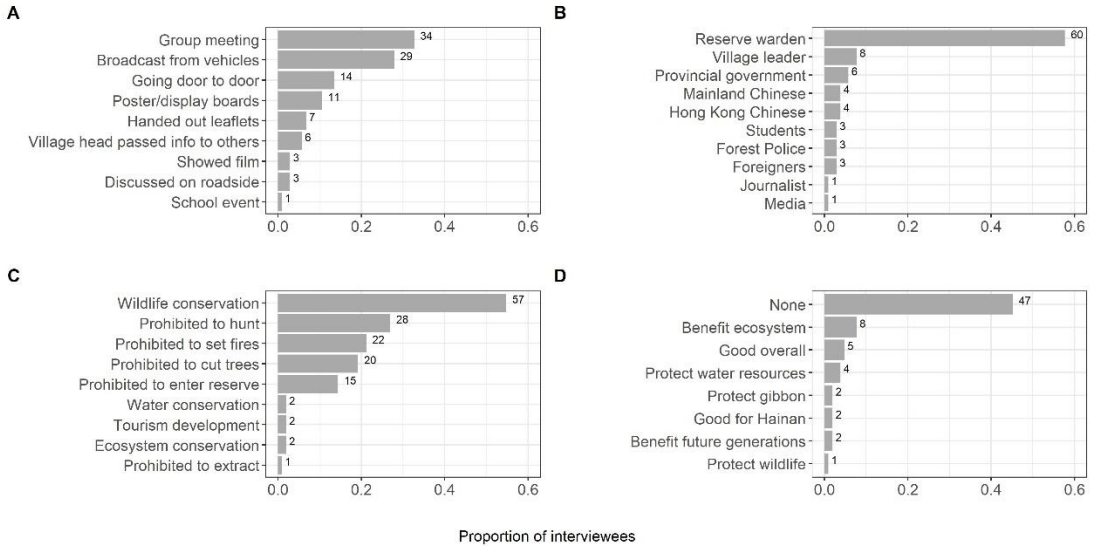

Figure 6.2 A, Proportion of interviewees who identified the medium of communication (n=92). **B,** Proportion of interviewees who identified who conducted local conservation outreach (n=84). **C,** Proportion of interviewees who reported different types of message (n=83). **D,** Proportion of interviewees who reported being told what the consequences would be for following the reserve's conservation management policies (n=66). Numbers on bars represent the number of interviewees who reported each response. Proportions are of the total of 104 interviewees who reported

reporting local conservation outreach; some interviewees listed more than one reported response within each question.

The majority of identified sources of information were nature reserve wardens or officials (60/84). The next most identified were village leaders (8/84), and provincial government staff (6/84). Other identified sources, reported by 19 interviewees, included people from mainland China, people from Hong Kong, students, police, foreigners, journalists, and the media or "*guanggao*" (including posters, banners, slogans, and the news). Gender (binomial GLMM, n = 191, $\chi^2 = 8.517$, df = 1, p = 0.004) and education level (binomial GLMM, n = 191, $\chi^2 = 9.707$, df = 3, p = 0.021) significantly predicted whether interviewees could report the source of information. Men were more likely to report than women (odds ratio = 4.00, 95% CI = 1.58 – 10.13, p = 0.004), and interviewees with up to primary school level education were more likely to report than those with no schooling (Tukey post-hoc test, estimate = 1.793, standard error = 0.578, z-value = 3.101).

Gender (binomial GLMM, n = 191, $\chi^2 = 5.251$, df = 1, p = 0.022) and education level (binomial GLMM, n = 191, $\chi^2 = 10.193$, df = 3, p = 0.017) significantly predicted whether interviewees could report the content of outreach activities. Men were more likely to report content compared to women (odds ratio = 2.58, 95% CI = 1.15 – 5.78). Interviewees who had attended up to primary school and middle school level education were both significantly more likely to report content compared to those with no schooling (Tukey post-hoc tests, primary school, estimate = 1.578, standard error = 0.515, z-value = 3.065, p = 0.002; middle school, estimate = 1.181, standard error = 0.496, z-value = 2.380, p = 0.017).

Slightly more interviewees reported positive messages about the benefits of conservation (58/83) than negative messages that prohibited activities in the reserve (55/83), although there were more reported types (5) and individual mentions (86) of different negative messages (**Figure 6.2**). The single most reported message was about wildlife conservation, mentioned by 57 interviewees. Reporting of positively-framed messages was significantly predicted by education level (binomial GLMM, n = 78, $\chi^2 = 8.117$, df = 3, p = 0.044), with interviewees possessing up to primary school level education being more likely to report positive messages compared to those with no schooling (Tukey post-hoc test, estimate = 2.304, standard error = 0.837, z-value = 2.752, p = 0.006). No predictors were significantly associated with reporting negatively-framed messages.

Of the interviewees who said they could report what they were told about the consequences of following the reserve's conservation management policies, 71.2% (47/66) stated that there were

no consequences, while 28.8% (19/66) listed specific consequences, including protection of the forest ecosystem, water resources, wildlife and/or gibbons, and benefits for future generations, Hainan or China. Five interviewees reported being told that conservation is 'overall a good thing' but did not provide more detail. Gender (binomial GLMM, n = 191, $\chi^2 = 12.624$, df = 1, $p < 0.001$) significantly predicted whether interviewees could report these consequences. Men were more likely to report than women (odds ratio = 6.66, 95% CI = 2.34 – 18.97, $p < 0.001$).

2. Awareness and salience of threatened species

In total, 20.8% (44/212) of all interviewees were able to free-list species they thought were threatened in China, 57 could do so for Hainan, and 36 could do so for both China and Hainan, while 147 provided no response. There was a statistically significant relationship between interviewees who free-listed threatened species for China and those who free-listed threatened species for Hainan (chi-squared = 81.74, df = 1, p = 0.001).

The Hainan gibbon was the most frequently listed and most salient threatened species for China (28 people), followed by giant panda (*Ailuropoda melanoleuca*) (11 people) and wild boar (*Sus scrofa*) (nine people). The Hainan gibbon was also the most frequently listed and most salient threatened species for Hainan (41 people), followed by rhesus macaque (*Macaca mulatta*) (10 people) and wild boar (nine people). Listing frequency matched salience for these species for both China and Hainan (**Figure 3**). Sambar deer (*Rusa unicolor*), Chinese pangolin (*Manis pentadactyla*), and carnivores including tiger (*Panthera tigris*), Asiatic black bear (*Ursus thibetanus*), clouded leopard (*Neofelis nebulosa*) and civets were also listed by a few interviewees for both China and Hainan, but were of low salience.

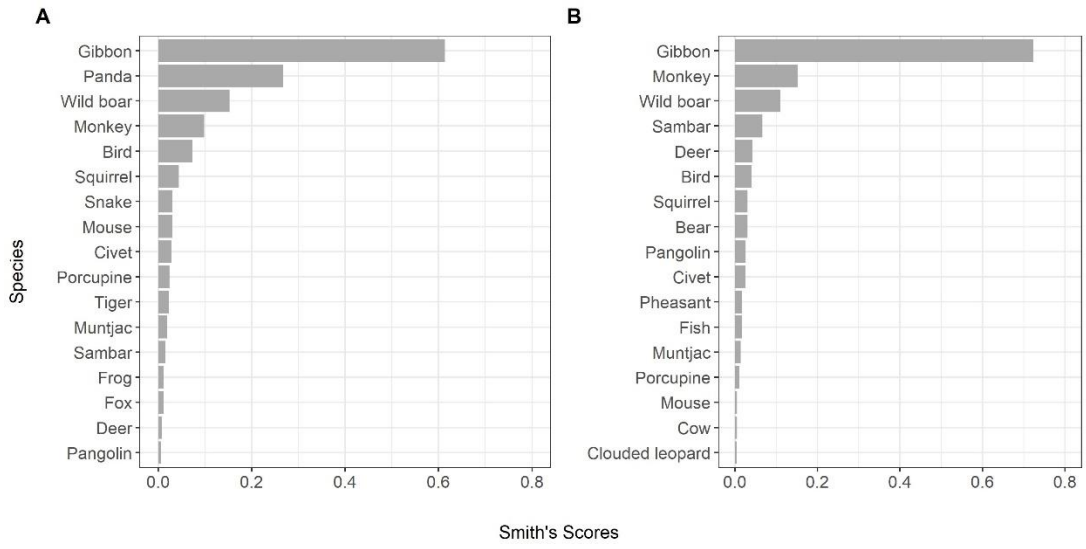

Figure 6.3 Smith's scores of salience for free-listed species that interviewees perceived as threatened in (**A**) China (n=44), and (**B**) Hainan (n=57).

Of the subset of Li ethnicity interviewees included in statistical analyses (n = 192), 22 (23.4%) could free-list species they thought were threatened in China, 34 (36.2%) could do so for Hainan, and 26 (27.7%) mentioned the Hainan gibbon when asked about threatened species in either China or Hainan (**Figure 4**). No significant predictors were associated with interviewees' ability to free-list threatened species in China, but interviewees who reported local outreach activities were significantly more likely to be able to free-list threatened species in Hainan (binomial GLMM, n = 191, $\chi^2 = 10.205$, df = 1, p = 0.001; report outreach, odds ratio = 3.77, 95% CI = 1.67 – 8.52, p = 0.001). Reporting of outreach activities (binomial GLMM, n = 191, $\chi^2 = 7.671$, df = 1, p = 0.006) and education level (binomial GLMM, n = 191, $\chi^2 = 12.462$, df = 3, p = 0.006) significantly predicted whether interviewees listed the Hainan gibbon. Gibbons were more likely to be free-listed by interviewees who reported local outreach (odds ratio = 3.65, 95% CI = 1.46 – 9.13, p = 0.006), and by interviewees with high school level education or above compared to those with no schooling (Tukey post-hoc test, estimate = 1.736, standard error = 0.693, z-value = 2.505, p = 0.012).

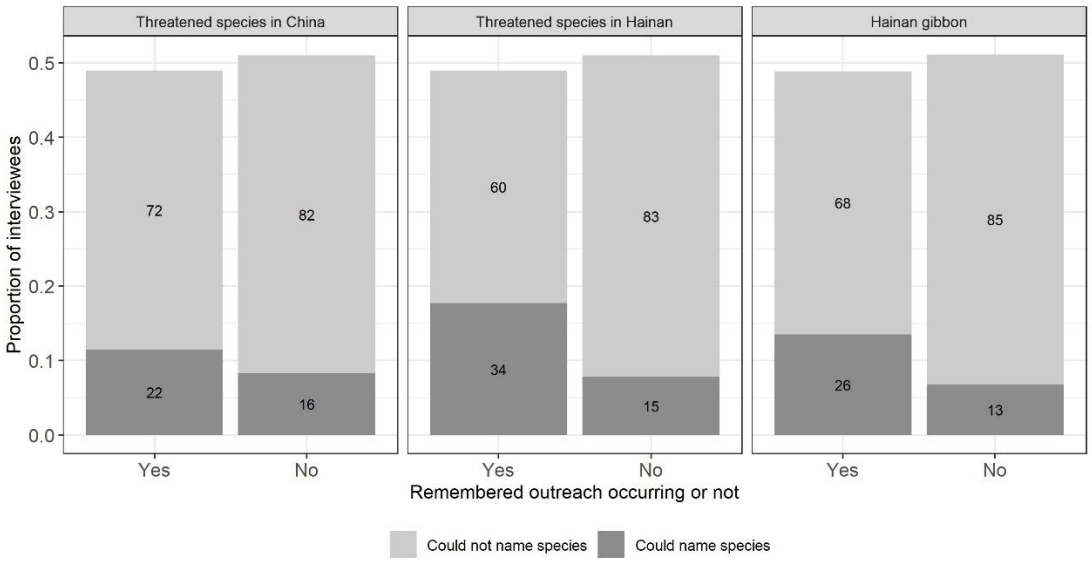

Figure 6.4. Proportions of the subset of interviewees included in statistical analyses (n=192) who could name at least one Chinese species, one Hainanese species, and the Hainan gibbon when asked to free-list threatened wildlife species. Pairs of bars in each panel show comparisons for

each response between interviewees who reported local outreach activities and those who did not report. Numbers on bars show number of interviewees who could name species.

DISCUSSION

Our study provides a nuanced understanding of the retention and perceptions of conservation outreach activities by local people living in a conservation-priority landscape, with wider implications for understanding the effectiveness and optimal design of environmental education programmes. Among the people interviewed around a Chinese protected area that have been exposed to conservation outreach, we observed higher levels of reporting how outreach activities were conducted and by whom, compared to knowledge about the content of these activities, indicating that the medium rather than the message has been preferentially reported by people living within this landscape. Relatively few people also reported what they had been told about the consequences of following conservation management policies, which indirectly reflects a low level of understanding of the protected area's purpose (cf. Qian et al., in press). These findings highlight the need to identify appropriate messaging techniques that increase knowledge of locally relevant conservation information, and to evaluate awareness of different conservation messaging approaches across other social-ecological systems.

For four of the five aspects of conservation outreach investigated in our study, higher levels of reporting were predicted by male gender and higher education level. These findings are consistent with previous investigation of other patterns of local knowledge about gibbons in communities around BNNR (Turvey et al., 2017; Qian et al., in press), with correlates of conservation awareness in other social-ecological systems across China and southeast Asia (Allendorf and Yang, 2017; Nyhus et al., 2003), and with other studies demonstrating that education is related to increased awareness of local conservation issues and pro-conservation attitudes (Padua, 1994; Xiong et al., 2016). Gender-specific conservation outreach activities should therefore be considered to reduce this observed imbalance, although further assessment should also be conducted to identify the primary reasons why male and female interviewees might have different levels of awareness or access to information within this system, and whether gender-specific activities might impact local biodiversity in different ways (cf. Xiao and Hong, 2010; Ding et al., 2014). We also note that in landscapes that are biologically and culturally unique, formal schooling that is not contextualized locally could lead to a decrease in awareness of the local environment (Howe et al., 2012; Reyes-García et al., 2010). Practical approaches to maximize local outreach effectiveness within this and other priority systems could include improving the capacity of educational resources, collaboration between conservation NGOs and researchers

with schools, incorporating non-utilitarian values of wildlife (e.g., "pride") into activities, and tailoring programmes to account for the specific demographic, socio-economic and cultural backgrounds of local audiences (Jones et al., 2019; Kidd et al., 2019). We acknowledge that this study is limited in scope and scale and may not be demographically representative of the entire local population (e.g. people who have left the villages for elsewhere), but insights are still informative for conservation management in the local area since the target audience would be people who still live in these communities.

Interviewees in this study were more aware of conservation outreach messages that emphasized prohibited activities within the reserve, rather than messages about the benefits that people might receive from conservation. We lack sufficient information on whether more positively or negatively framed messages were originally communicated to local people, so it is not possible to establish which type of framing leads to better retention of conservation outreach messages. Despite this, our results suggest that there is scope to modify dialogue between communities, reserve authorities and conservation organizations about the benefits and costs of conservation. Negative attitudes can be reinforced if messaging focuses on penalties and exclusion from resource use (Ferraro & Pattanayak, 2006), and whilst "wildlife conservation" appears to be a positive outcome, this topic may not encourage favourable attitudes or compliance with reserve management if it is associated with disadvantages of living next to protected areas (Chan et al., 2007; Nilsson et al., 2016). Conservation outreach could instead focus on the benefits of successful conservation and the intrinsic value of wildlife and unique local biodiversity, potentially utilizing approaches from other sectors that frequently use campaigning to alter perceptions and behaviors (e.g., climate change mitigation, public health; Maibach et al., 2008; Morton et al., 2011), and ensuring clear delivery of messaging to increase overall retention (Novacek, 2009). Our results also show that reserve staff were the most frequently identified group of people associated with conducting outreach. However, nature reserves in China typically have limited resources, and reserve staff often have low capacity (Xu et al., 2012). Increased involvement and collaboration with conservation professionals could therefore be a useful approach to improve the effectiveness of outreach activities and reduce the workload of reserve staff.

Although the medium of past conservation outreach around BNNR was more widely reported than the message, our results also reveal that knowledge of conservation outreach having occurred was statistically correlated with interviewees' ability to name the Hainan gibbon as a threatened species, and to free-list species they perceived as threatened in Hainan but not

elsewhere in China. Indeed, whereas the giant panda is arguably the most famous conservation icon in China, appearing frequently in national media (Buckingham et al., 2013; Huang & Wang, 2020), more interviewees around BNNR free-listed Hainan gibbons than giant pandas when asked about threatened Chinese species. The Hainan gibbon is increasingly promoted as a flagship species of BNNR (Liu et al., 2020) and has been the focus of a range of conservation outreach activities in local communities (Qian et al., in press). Even though direct reporting of conservation messaging might be relatively limited by stakeholders in this system, these additional findings might therefore provide indirect evidence that past outreach around BNNR has successfully raised the profile of key threatened species. However, educational activities to support Hainan gibbon conservation have included not only village-based education sessions but also construction of permanent billboards and murals displaying gibbon-related information and images (Fellowes et al., 2008; Qian et al., in press), so it is possible that increased local salience about gibbons as threatened species might reflect knowledge uptake from these visual displays rather than from direct outreach activities by reserve staff or other individuals. Indeed, such 'media-rich' environments containing numerous information sources are known to be effective frameworks for improving knowledge in other systems (Zukin & Snyder, 1984). Gibbons are also widely recognized and viewed in positive terms (e.g., as "noble" animals) both within traditional Chinese culture (van Gulik 1967; Geissman 2008) and within the specific folklore and indigenous knowledge systems of Li and Miao communities around BNNR (Turvey et al., 2018), which may further enhance their local salience.

The relative salience of other free-listed species provides further insight into local perceptions and conservation outreach. Wild boar and macaque, the next-highest named species for Hainan and/or China, are both listed as Least Concern by IUCN (2020) but are protected nationally as Category II species in China (Standing Committee of the National People's Congress (2018). The higher salience of these species might reflect the fact that both are still seen relatively regularly around BNNR (Turvey et al., 2019), whereas species that have experienced earlier declines and are now already extremely rare and hard to detect might have lower salience among local people due to personal and generational amnesia of past ecological conditions, or shifting baseline syndrome (Papworth et al., 2009; Turvey et al., 2010). Notably, the *Critically Endangered* Chinese pangolin (*Manis pentadactyla*) was once an abundant and economically important target species for local hunting and trade around BNNR, but is now very rare (Nash et al., 2016); this species was mentioned by only two interviewees for Hainan and one interviewee for China, despite the increased focus on pangolins in conservation awareness-raising campaigns and media in China (Harrington et al., 2018). Many other threatened Hainanese species that are also the

focus of regional conservation efforts were not mentioned at all by interviewees, including native turtle species, Eld's deer (*Rucervus eldii*), and Hainan peacock pheasant (*Polyplectron katsumatae*) (IUCN 2020). This generally low level of knowledge about wider threatened biodiversity highlights further opportunities for local awareness-raising. Advertising research has demonstrated that focusing on one issue or item in marketing campaigns can unintentionally reduce the uptake of information on wider topics (Alba & Chattopadhyay, 1986; Jin et al., 2008). Instead of focusing only on the Hainan gibbon, a 'flagship fleet' approach to conservation outreach might therefore be more effective to raise local knowledge and support for conserving Hainan's unique but threatened biodiversity (Veríssimo et al., 2014). Whilst selection of locally appropriate species to create a flagship fleet requires careful consideration (Bowen-Jones & Entwistle, 2002; Veríssimo et al., 2014), our data on local awareness and salience of threatened species around BNNR provides a quantified baseline to guide future conservation outreach activities.

Effective communication through outreach activities can be a powerful way to engage local communities in conservation (Bickford et al., 2012; Nilsson et al., 2016). Indeed, reporting of awareness-raising is shown to be associated with positive attitudes towards species conservation in other systems (Howe et al., 2012), making it important to ensure a longer impact for outreach activities beyond the duration of a single event. Communication techniques should be chosen carefully based upon conservation objectives, and guided by research into how both the message and the medium can impact the outcomes of outreach activities, with effective measurement of both of these aspects to improve evaluation (Duthie et al., 2017; Giannetta, 2018). Evaluation is especially important since existing studies of environmental messaging show that many factors can impact attitude and behavioral change (Howe et al., 2012; Smith & Sutton, 2008; van der Ploeg et al., 2011). Because the lack of robust studies evaluating the effectiveness of conservation interventions limits the usefulness of evidence to practitioners (Christie et al., 2020), assessments of the responses to conservation outreach that are locally contextualized, even in the absence of details of such activities, can still be valuable for conservation management. We demonstrated that quantifying salience of wildlife species also constitutes an effective approach for revealing gaps in local knowledge and providing directions for urgent conservation action, especially in areas undergoing rapid environmental change and biodiversity loss. Conservation practitioners must continue to improve their communication techniques, especially given the recognized shortfall in social marketing skills and training opportunities within the conservation sector despite their widely perceived importance (Green et al., 2019; Kidd et al., 2019). Overall, conservation outreach must engage more actively with theories and empirical evidence available

from other disciplines to become more effective, and maximize its ability to support positive change for biodiversity.

DATA AVAILABILITY

The datasets collected during this study are available from the corresponding author upon request. Data are not publicly available because they contain potential sensitive information on the interviewees' location, behavior, and personally opinions that may compromise their identities and safety. Research was approved by Royal Holloway University of London's Research Ethics Committee (ID 535).

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CONFLICT OF INTEREST

The authors declare no conflicts of interest.

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SUPPORTING INFORMATION

Table 6.1 Available information on past conservation awareness-raising activities in villages surrounding Bawangling National Nature Reserve.

Type of activity/description	Area/villages	Time/year	Reference
Regular visits of reserve wardens to all local communities, for awareness-raising about reserve regulations	All villages around BNNR	Ongoing	BNNRMO *pers. comm.* 2018
Promoting local communities' engagement in natural resource management in Hainan gibbon habitat	Qingsong township	2003	FFI 2008
Environmental education outreach to improve awareness, change values and attitudes, and engage local people in sustainable use of natural resource and in the conservation of gibbons and their habitat.	Qingsong township	2005	FFI 2008
Hainan gibbon drawing contest in schools; photography activity in students' home villages; activities on Hainan gibbon conservation and environmental awareness	6 villages in Qingsong township	2007	FFI 2007
Teacher training courses on environmental education methods, 14 teachers and students visited a botanical garden and geological park	2 schools in Qingsong township	2007-2008	FFI 2007
Hainan gibbon conservation awareness activities in schools, support students' extracurricular activities about conservation and environmental protection	6 villages in Qingsong township, 1000 students and their parents	2007-2008	FFI 2007
Improve knowledge on conservation and sustainable development through establishment of a 'Gibbon Community Learning Center'	Qingsong township	2007-2008	FFI 2007
Distributed 2000 calendars with student's drawings about Hainan gibbon conservation	Qingsong township	Jan 2008	FFI 2008
Mural painting of gibbons and their forest habitat involving local school children	Miao village, Qingsong township	Date unknown	KFBG Guangzhou workshop presentation 2018

Hainan gibbon fun fair in school on International Gibbon Day	No data	2013, 2015	KFBG website 2016
Hainan gibbon billboard	Qingsong township, road junction	No data; Billboard is still there	KFBG Guangzhou workshop presentation 2018
Hainan gibbon calendars and Chinese New Year decorations distributed to community members	No data	No data	KFBG Guangzhou workshop presentation 2018
Demonstration of sustainable agriculture and beekeeping techniques to promote conservation of Hainan gibbon habitat; distributed 10,000 bitter cardamom seedings to 50 households	At least in Miao village in Qingsong township	2016	KFBG Guangzhou workshop presentation 2018; KFBG website 2016

Fauna & Flora International China Programme (2007) *Community-based education for conservation of the Hainan gibbon*. Beijing: Fauna & Flora International China Programme.

Fauna & Flora International China Programme (2008) *Community-based capacity building and mainstreaming for conservation of the Hainan gibbon*. Beijing: Fauna & Flora International China Programme.

Fellowes, J.R., Chan, B.P.L., Zhou, J., Chen, S., Yang, S. & Ng, S.C. (2008) Current status of the Hainan gibbon (*Nomascus hainanus*): progress of population monitoring and other priority actions. *Asian Primates Journal*, 1, 2-9.

Kadoorie Farm & Botanic Garden (2016) China eco tales: working with local people, KCC bolsters the future of Hainan gibbons. Available at: https://www.kfbg.org/eng/blogs/hainan-gibbons-fair.aspx. Accessed 14 June 2019.

Kadoorie Farm & Botanic Garden (2018) Oral presentation given at "*Gibbon Conservation Technical Skills Meeting*". Guangzhou, China, 22-23 Apr 2018.

Table 6.2 Summary of demographic variables of the people interviewed in this survey and their responses to questions about reporting different aspects of environmental conservation activities and naming threatened species (n= 212). 10,000 yuan is equal to c. 1000 GBP. Some variables do not total to 212 people or 100% because not all interviewees answered all questions in the questionnaire.

Demographic variables			
14. Age (years)	**Mean**	**Median**	**Range**
	41.35	42	18-80
15. Gender	**Categories**	**Number**	**Percentage**
	Female	80	37.7
	Male	132	62.3
16. Ethnicity	Li	192	90.6
	Miao	11	5.2
	Han	9	4.2
17. Level of education	No formal education	66	31.1
	Primary school	51	24.1
	Middle school	74	34.9
	High school	14	6.6
	University	6	2.8
18. Annual household income (yuan)	≤ 10,000	160	75.5
	> 10,000	52	24.5
19. Time lived in current village (years)	Entire life	183	86.3
	Other	29	13.7

Response variables			
1. Reported activities occurred	Yes	104	49.1
	No/NA/Don't know	108	50.9
2. Reported medium of communication	Yes	92	43.4
	No/NA/Don't know	120	56.6
3. Reported who conducted activities	Yes	84	39.6
	No/NA/Don't know	128	60.4
4. Reported content of activities	Yes	83	39.1
	No/NA/Don't know	129	60.9
5. Reported what the result would be if they followed what was told in the activities	Yes	66	31.1
	No/NA/Don't know	146	68.9
6. Reported positively-famed messages	Yes	54	69.2
	No/NA/Don't know	24	30.8
7. Reported negatively-famed messages	Yes	53	67.9
	No/NA/Don't know	25	32.1
8. Could free-list at least one threatened species in Hainan	Yes	44	20.8
	No	168	79.2
9. Could free-list at least one threatened species in China	Yes	57	26.9
	No	155	73.1
10. Could free-list the Hainan gibbon as a threatened species in either China or Hainan	Yes	48	22.6
	No	164	77.4

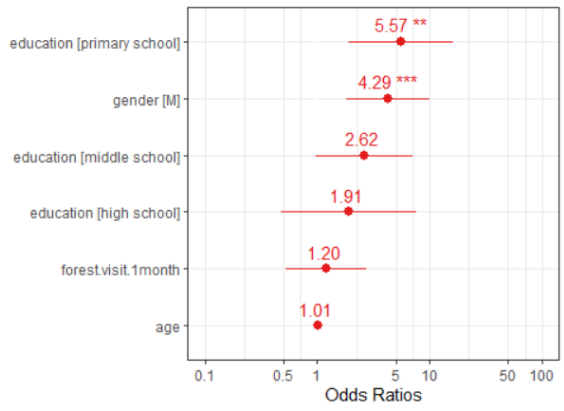
Table 6.3 Summary test statistics of all GLMM predictors and responses.

Responses	Predictors	Chi-square	df	p
1. Reported any outreach activities	Age	0.666	1	0.414
	Gender	11.354	1	**0.001**
	Education	10.287	3	**0.016**
	Visit forest more than once per month	0.195	1	0.658
2. Reported the medium of communication	Age	0.617	1	0.432
	Gender	11.307	1	**0.001**
	Education	8.635	3	**0.035**
	Visit forest more than once per month	0.011	1	0.917
3. Reported who conducted outreach activities	Age	1.367	1	0.242
	Gender	8.517	1	**0.004**
	Education	9.707	3	**0.021**
	Visit forest more than once per month	0.020	1	0.887
4. Reported the content of outreach activities	Age	0.419	1	0.517
	Gender	5.251	1	**0.022**
	Education	10.193	3	**0.017**
	Visit forest more than once per month	0.295	1	0.587
5. Reported what consequences there would be for following what was told	Age	1.162	1	0.281
	Gender	12.624	1	< **0.001**
	Education	4.360	3	0.225
	Visit forest more than once per month	0.342	1	0.559

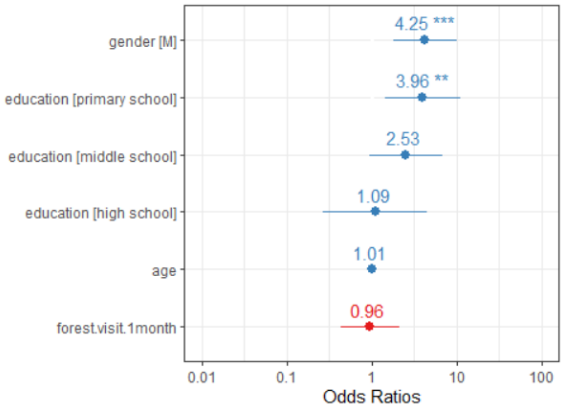
6. Reported positively-framed messages	Age	0.055	1	0.814
	Gender	2.398	1	0.122
	Education	8.117	3	**0.044**
	Visit forest more than once per month	0.029	1	0.865
7. Reported negatively-framed messages	Age	1.994	1	0.158
	Gender	1.957	1	0.162
	Education	3.128	3	0.372
	Visit forest more than once per month	2.672	1	0.102
8. Free listed threatened species in China	Age	1.006	1	0.316
	Gender	0.793	1	0.373
	Education	3.149	3	0.369
	Visit forest more than once per month	0.091	1	0.763
	Report any awareness-raising	1.399	1	0.237
9. Free listed threatened species in Hainan	Age	0.085	1	0.771
	Gender	0.733	1	0.392
	Education	7.372	3	0.061
	Visit forest more than once per month	0.676	1	0.411
	Report any awareness-raising	10.205	1	**0.001**
10. Free listed the Hainan gibbon	Age	0.316	1	0.574
	Gender	2.066	1	0.151
	Education	12.462	3	**0.006**
	Visit forest more than once per month	0.018	1	0.895
	Report any awareness-raising	7.671	1	**0.006**

Figure 6.5 Odds ratios of predictors of each GLMM with 95% confidence intervals. **A)** Reported any awareness-raising; **B)** Reported awareness-raising medium of communication; **C)** Reported who conducted awareness-raising; **D)** Reported awareness-raising content; **E)** Reported what consequences there would be for following reserve policies; **F)** Reported positively-framed messages; **G)** Reported negatively-framed messages; **H)** Free-listed threatened species in China; **I)** Free-listed threatened species in Hainan; **J)** Free-listed the Hainan gibbon.

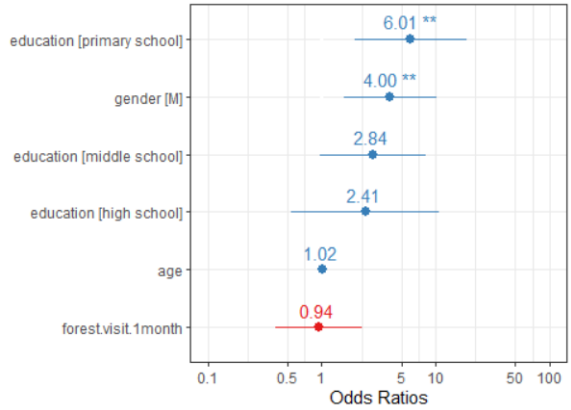
A)



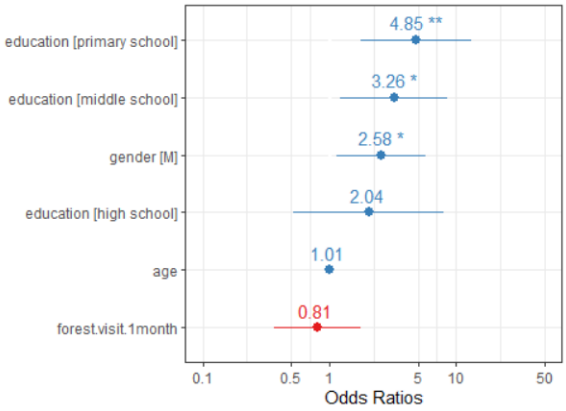
B)



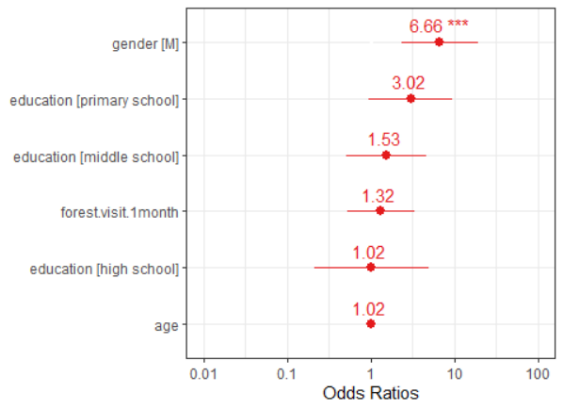
C)



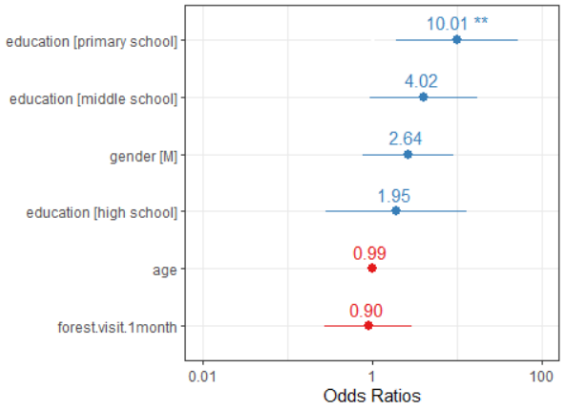
D)



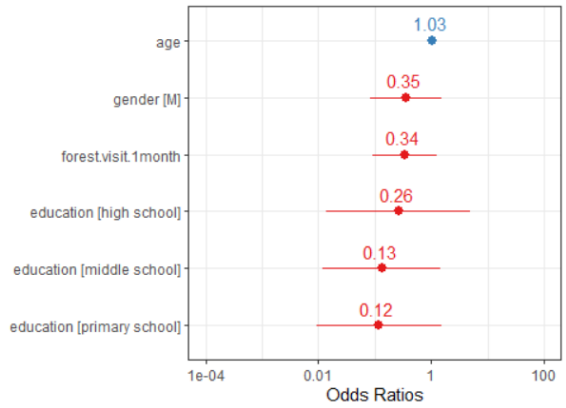
E)



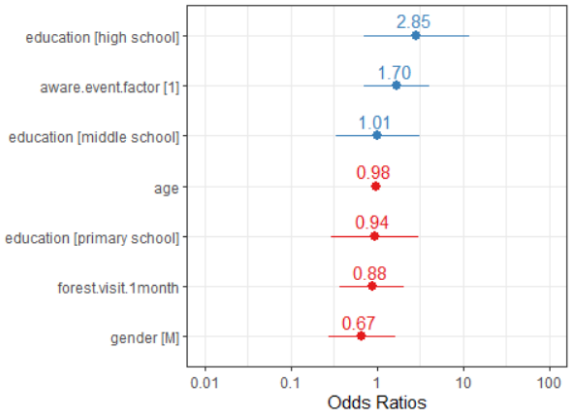
F)



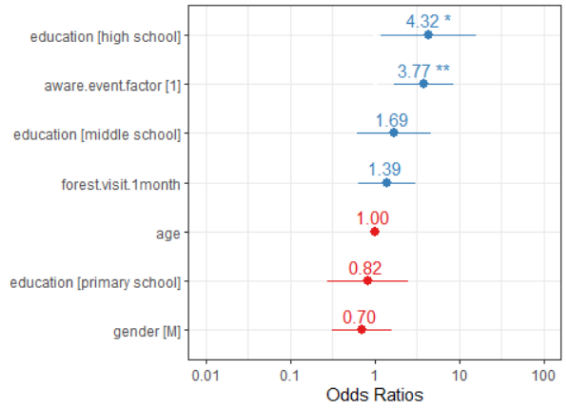
G)


age
gender [M]
forest.visit.1month
education [high school]
education [middle school]
education [primary school]
1.03
0.35
0.34
0.26
0.13
0.12
1e-04
0.01
1
100
Odds Ratios

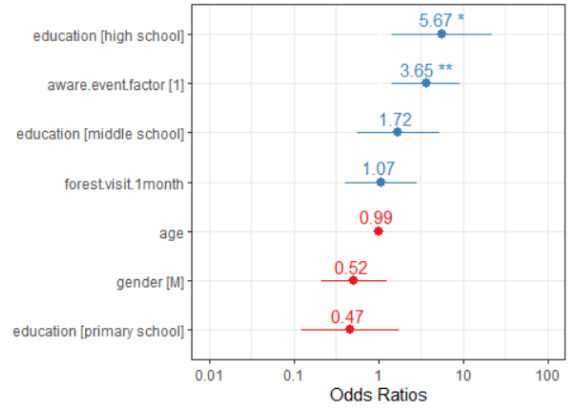
H)


education [high school]
aware.event.factor [1]
education [middle school]
age
education [primary school]
forest.visit.1month
gender [M]
2.85
1.70
1.01
0.98
0.94
0.88
0.67
0.01
0.1
1
10
100
Odds Ratios

I)


education [high school]
aware.event.factor [1]
education [middle school]
forest.visit.1month
age
education [primary school]
gender [M]
4.32 *
3.77 **
1.69
1.39
1.00
0.82
0.70
0.01
0.1
1
10
100
Odds Ratios

J)


education [high school]
aware.event.factor [1]
education [middle school]
forest.visit.1month
age
gender [M]
education [primary school]
5.67 *
3.65 **
1.72
1.07
0.99
0.52
0.47
0.01
0.1
1
10
100
Odds Ratios

CHAPTER 7

DISCUSSION

Human activities have direct impacts on conservation, and the perceptions of local people living alongside threatened species is known to influence conservation success (Bennett et al., 2017). There are compelling practical and ethical reasons for engaging with people who live alongside biodiversity in conservation research and practice (Agrawal & Gibson, 1999; Berkes, 2007; Brittain et al., 2020). Historically, local communities have often been marginalized in conservation management and excluded from decision making (Agrawal & Gibson, 1999; West et al., 2006). Such marginalization can be both caused and exacerbated when failing to include local perspectives in conservation research (Pyhälä et al., 2016). Community-nature interactions are complex and context-dependent, and each case therefore requires a thorough understanding of the multiple socio-ecological dimensions (Berkes, 2004). Understanding the complexity of local peoples' views can therefore be a stepping-stone for their further participation in conservation.

This thesis has addressed knowledge gaps in the human dimensions of conservation, by exploring patterns and drivers of local perceptions, focusing on communities around protected areas in Hainan, China. Key aspects examined include protected area access, perceptions of extinction and responsibility for conservation, responses to previous outreach activities, and knowledge of traded species. Gaining a better understanding of these aspects strengthens the foundation for future conservation work in Hainan, a biodiversity hotspot that is previously understudied but receiving increasing attention within China.

Local communities and biodiversity co-exist in Hainan's rural forested landscape mosaic, creating variation in ecological knowledge, awareness, and responses to conservation interventions. Local people's responses were influenced by location and demographic characteristics, but broader patterns of resource use and access, understandings of extinction, perceptions about trade, and response to conservation outreach provide useful conclusions for conservation in the area. Importantly, local perspectives reveal shortfalls and opportunities in the current conservation landscape, which could be used as baselines on which to build conservation programs. Lessons learned from Hainan's local community-protected area landscape expands the conservation evidence base on human-nature interactions and highlights transferrable questions to investigate in other comparable systems. This chapter expands upon the findings and discusses their wider relevance to the field.

1. ENGAGING WITH THE LOCAL EXPERIENCE IN CONSERVATION

Understanding the local experience is a prerequisite to constructive engagement with people in conservation. How local people experience their environment impacts how they will respond to conservation interventions and management practices. Using data empirically gathered from local perceptions, rather than assumptions about perceptions, increases the likelihood of success. Overall, my findings point to a degree of dependency on forest protected areas for resources, a willingness to comply with conservation regulations, but a low level of perceived responsibility to participate in conservation. People living around seven of Hainan's forest protected areas were found to have a high desire for access to the forest reserve, but refrain due to fear of punishment for violating conservation policies (Chapter 3). Value-generating activities identified by local people were mainly associated with subsistence purposes, highlighting the need for firewood as a source of energy (Chapter 3). While people around BNNR largely agreed that firewood collection should be allowed for subsistence use, the majority did not think that hunting is appropriate (Chapter 4). Yet, the hunting and trapping of animals was frequently mentioned as an important activity, revealing conflicting attitudes held by potentially different groups of local people towards the use of wildlife and conservation.

Local people's relationships with protected areas also have implications for future scenarios, in which increasing wildlife presence or conflict might be anticipated, as a result of potential recovery of wildlife populations or planned reintroductions. For example, in Houmiling Provincial Nature Reserve, adjacent to BNNR, nearly 300 captive bred endangered Eld's deer (*Rucervus eldii*) were reintroduced in the 2000s, but subsequently underwent decline, partially due to poaching (Wong et al., 2018; Zeng et al., 2005). Local people were not consulted prior to release, nor involved in the decision-making process (Liu Hui, *pers comm*, 2020). The potential mismatch between local attitudes, behaviors, and conservation objectives highlights the need to include local perspectives at all stages of conservation planning. Other potential conflicts with local people may arise alongside increasing wildlife populations. Crop raiding by wild boar and primates is common in developing regions of Southeast Asia, negatively impacting local livelihoods around protected areas (Campbell-Smith et al., 2010; Linkie et al., 2007). Obtaining a fine-scale understanding of local people's relationship with protected areas can therefore help conservation management anticipate potential conflicts and be better prepared for mitigation, and make conservation planning more robust and comprehensive overall.

My findings are consistent with the existing body of knowledge showing the complexity of community-protected area relationships (Brooks et al., 2012; Waylen et al., 2010). It can be

inferred from my research that improving conservation depends on a multitude of factors, which are specific to local communities, such as perceptions of fair governance, ownership, alternatives for natural resources, and trade-offs. Local people viewed governmental authorities as having the most responsibility for conservation around BNNR, despite perceiving local human activities being the main drivers of wildlife decline and extinction (Chapter 4). Indeed, exclusion from access to protected areas and participation in decision making can prevent local people from taking up more ownership of pro-conservation initiatives because of perceptions of little control in the processes and outcomes (Bennett & Dearden, 2014, Lele et al., 2010; Nuno et al., 2021). Instead, gaining benefits from conservation, such as increased economic value from livelihoods, and autonomy in resource management, has been shown to increase pro-conservation behavioral changes (Nilsson et al., 2016). Furthermore, responses to well-meaning interventions can be affected by various local conditions and ignoring these dynamics may result in unintended consequences (Short et al., 2018). Therefore, the local experience should be routinely included as a key component in conservation planning and management.

Finally, variation local peoples self-reported behaviors and attitudes found around Hainan's forest protected areas warrant further study of how conservation management history differs between reserves, and to what extent local communities' relationships with the forest reserves are site-specific. In China, nature reserves are typically categorized into four hierarchical levels: national, provincial, municipal and county, although different governmental departments have independent classification systems, resulting in fragmented management and varying financial support (Guo & Cui, 2015; Xu et al., 2012; Xu et al., 2019). In early 2020, China's first national parks were opened after a piloting phase that began in 2015, and reforming management remains a priority to reach conservation targets (Li et al., 2016; Xu et al., 2012). Given the diverse ecological and social contexts of these protected areas, and each potentially having unique management histories, the impacts of conservation management on local communities wellbeing should also be expected to vary greatly.

At the time of research, there is planned relocation of villages located within the newly demarcated boundaries of Hainan's Tropical Rainforest National Park (Zong, 2020), which includes all of the protected areas included in this thesis. How the affected communities will respond, and to what extent their responses are underpinned by perceptions of the new national park system and its management, is beyond the scope of this thesis. Case studies from South Africa and Europe have shown that place attachment, including identify and attachment, affects local communities' responses to conservation management policies (Cundill et al., 2017;

Hirschnitz-Garbers & Stoll-Kleemann, 2011). Therefore, local responses to the new national park will be especially important for Hainan's conservation and worthy of further investigation. Indeed, various dimensions of effective governance such sociopolitical stability and trust, are known to affect the effectiveness of conservation areas worldwide both positively and negatively (Amano et al., 2018). In conservation landscapes where governance structures change frequently, relationships between the community and conservation can be redefined rapidly, making community perspectives all the more important to monitor on a long-term basis and key to achieving socio-ecological resilience (Bennett, 2016; Berkes, 2004; Folke, 2002). Overall, my findings highlight the importance of including local perceptions as an integral component in protected area management, since site-specific patterns may limit the replication of management practices from one reserve to another, but ultimately underpin conservation outcomes.

2. ECOLOGICAL KNOWLEDGE AS BRIDGE BETWEEN DATA AND PRACTICE

In resource-dependent communities, patterns in local and traditional ecological knowledge reflect complex relationships between humans and wildlife (Berkes et al., 2000; Gadgil et al., 1993). Knowledge can be acquired through learning and accumulation of experience and is therefore dynamic in responding to changes in both the physical environment and society (Berkes et al., 2000). In areas where local communities have minimal previous involvement in conservation, assessing ecological knowledge and perceptions of key species and concepts can contribute to a more robust evidence base and help transfer data to practice. Despite living next to the habitat of the world's rarest primate, many local people around BNNR were not certain that species extinctions could occur (Chapter 4). New evidence on local knowledge, awareness, and attitudes gathered in this thesis can therefore be used as a foundation for improving community engagement in the Hainan conservation landscape. Additionally, my results advocate for proactively including different world views as a way to increase trust between researcher and research participants, and between conservation management and relevant local communities.

When working with various stakeholders, key conservation concepts should be clearly defined to achieve better mutual understanding for practical reasons. In Chapter 4, my results demonstrate that, someone having awareness of local species disappearance does not mean they will understanding the term 'extinction', or considering extinction possible, despite these concepts being associated (Chapter 4). Obtaining baseline knowledge of how various stakeholders understand ecological concepts is therefore the first step to reaching consensus, and also has

direct consequences for carrying out conservation action planning, public outreach, and policy making. The confusion of concepts can lead to miscommunication that prevent consensus being reached, especially when culturally and demographically diverse groups of people are involved. Because successful conservation relies on the proactive engagement with people from various sociocultural backgrounds (Bennett et al., 2016), the study of local understandings of extinction therefore has tremendous pragmatic value.

Varying degrees of understanding of extinction observed around BNNR (Chapter 4) suggest this is a complex topic that has direct conservation implications. Chinese environmental history, continuous over several millennia, can be characterized by increasing human population and declining wildlife throughout the imperial and modern period (Elvin, 2004; Marks, 2017). Species disappearances from densely settled river floodplains, including those of large conspicuous ungulate species such as rhinoceros and elephants, have also been documented in early historical records (Lander & Brunson, 2018). Despite awareness of such declines, little is known of how the absolute and irreversible nature of extinction is understood, nor of if, when, why, and how intentional conservation measures have been taken to prevent extinctions. Instead, widespread wildlife decline driven by deliberate targeted hunting further accelerated in the 20th century (Shapiro, 2001). For example, Imperial hunting reserves provided aristocracy with stable supplies of game animals, and may have inadvertently saved the last herd of Pere David's deer (*Elaphurus davidianus*) from extinction (Schafer, 1968; Turvey et al., 2017). But whether the maintenance of such reserves was aimed at preventing extinctions is unclear.

Examining collective awareness of recent species extinctions further help recognize challenges facing conservation today. The extinction of the Yangtze river dolphin (*Lipotes vexillifer*) received high profile coverage domestically and internationally, and likely contributed to the increased conservation attention for the Yangtze finless porpoise (*Neophocaena phocaenoides asiaeorientalis*), the only other cetacean species in the Yangtze River system (Zhao et al., 2008). It is possible that the porpoises' association with the Yangtze river dolphin's extinction prompted immediate conservation prioritization and publicity for the finless porpoise. However, modern day extinctions, even of culturally and economically important species such as the south China tiger (*Panthera tigris amoyensis*) and the Yangtze paddlefish (*Psephurus gladius*), are often occurring unnoticed by the general public except for the people who have direct experience with the species (Tilson et al., 1997; Turvey, in press; Zhang et al., 2020). For less charismatic species and species under high demand for consumption, awareness of the significance of their extinction may be much more difficult to raise. Additionally, it is important to note that awareness of the

decline of threatened species and knowing the causes does not necessarily induce pro-conservation behavior change (Vallejo-Betancur et al., 2018; Waylen et al., 2009). Other motivations such as economic incentives may outweigh conservation motivations despite knowing the negative impacts to wildlife or associated penalties (Nilsson et al., 2016; Reddy et al., 2017).

Furthermore, species extinctions can be undetected by local people and scientists alike. 'Silent extinctions', or the loss of species and distinct genetic lineages before they are described and afforded protection, pose further challenges to conservation in rapidly changing environments (Howard & Bickford, 2014). For example, new lineages of the Chinese giant salamander (*Andrias davidianus and Andrias sligoi*) were described at the same time they were declared to be on the brink of extinction in the wild (Turvey et al., 2018; Yan et al., 2018). Furthermore, the rapid loss of cultural memory and ecological knowledge among local communities is then further exacerbated by the exclusion from protected areas and interaction with nature, resulting in disconnection with native wildlife and conservation issues (Turvey, in press). My research contributed new insights on local ecological knowledge about species extinction, providing evidence to inform future conservation work (Chapter 4). The complexity found around extinction perceptions are not only important for understanding the trajectory of wildlife conservation in China, but are also illuminating for global conservation if explored comparatively across cultures and countries.

Lastly, social surveys on ecological knowledge are not only useful for gathering data for conservation, but can also bridge the gap between research and practice by including and validating local perceptions. Conducting research in Hainan showed that discussing ecological knowledge with local community members was not considered problematic, and a viable way to gather additional information on more sensitive issues such as wildlife trade. When presented with photographs and questions about wildlife knowledge, local people were generally interested and at ease. Moreover, the positionality of myself and my research assistants as students, unaccompanied by local governmental officials during interviews, was likely to have helped gain the trust of interviewees. This was evidenced by many people voicing their grievances to us regarding poverty, construction projects, compensation schemes, and corruption. Nonetheless, in China, social science research has shown that a high level of non-response could be expected from interviewees for questions that are politically sensitive (Ratigan & Rabin, 2020). Additionally, falsified answers and underreporting of attitudes and behaviors deemed socially undesirable could be given out of fear of punishment by authorities. In an effort to promote its

image of an ‘eco-civilization’, China has increased prosecution of wildlife crime dramatically in recent years, reinforcing the state’s ‘authoritarian environmentalism’ approach (Davies & Wismer, 2013; Li & Shapiro, 2020). It is therefore unsurprising that supporting that local people around BNNR perceived of the government as mainly being responsible for conservation (Chapter 4). Local people, largely marginalized and excluded from natural resource management in the past, are therefore even less likely to openly express disagreement with authorities or admit to breaking rules (Davies & Wismer, 2013). Nonetheless, attitudes towards government policies are important for gaining in-depth understanding of many conservation issues. Approaches from other disciplines such as anthropology and criminology (Wong, 2019) and sensitive questioning techniques (Nuno & St. John, 2014) should then be adapted to the local situation to maximize the usefulness and reliability of data collected from community interviews. Researching local knowledge about wildlife can therefore also strive to serve as a bridge for building trust between the researcher and community.

3. PERCEPTIONS REVEAL CONSERVATION OPPORTUNITIES

Results in this thesis point to the various ways in which local awareness of species relate to anthropogenic threats to wildlife, and highlight opportunities for improved conservation by incorporating local perceptions. In communities around BNNR, overall salience of threatened species was high for mammals but low for other taxa, especially reflected in the uneven knowledge of potentially traded turtle species (Chapter 5). Local people did, however, perceive turtles as being widely traded irrespective of species, increasing the potential risk of turtles being collected indiscriminately for consumption and trade (Chapter 5).

Patterns in wildlife perception can be better contextualized against the wider background of conservation issues, including evolving regulations and governance. When communicating wildlife conservation goals and priorities, mismatches between conservation statuses of species on the IUCN Red List, CITES appendices, and national protected status may give confusing signals to the public. For example, the low level of protection of turtles in Chinese legislation may be one reason local awareness of native species is uneven (Chapter 5). At the time of research, none of the ten turtle species included in my research were listed as Level I protection under the Chinese Wild Animal Conservation law (Standing Committee of the National People's Congress, 2018). In contrast, all ten species except the Chinese softshell turtle are either globally Endangered or Critically Endangered (IUCN Red List, 2020), and half of the species are listed

under CITES Appendix II, the other half listed under Appendix III (CITES, 2019). Additionally, three are EDGE species (big headed turtle, rank 19; black-breasted leaf forest turtle, rank 51; and wattle-necked softshell turtle, rank 63), prioritized for conservation internationally not only because they are global endangered but also for their evolutionary distinctiveness (Gumbs et al., 2018, EDGE of Existence, 2017). To researchers and conservation organizations, prioritization for research and conservation attention is more likely to be aligned with international frameworks; but for the public, national level protection status will be most relevant as it affects policy and law enforcement. This misalignment could result in global conservation priorities not being reflected at the local scale. Indeed, comparisons between national and international red lists are needed to identify weaknesses in conservation prioritization systems (Brito et al., 2010; Miller et al., 2007). Where discrepancies exist, my research demonstrates that local perceptions of threatened wildlife could help identify such shortfalls and reveal opportunities for improvement.

My research findings point to an important but often overlooked aspect of conservation outreach, which is the influence of the individual or organization that is delivering the message (Kusmanoff et al., 2020). Around BNNR, local people mainly associated the delivery of outreach activities (Chapter 6) and the responsibility of doing conservation (Chapter 6) with government authorities instead of conservation organizations or professionals. While in my research it was not possible to quantify whether government authorities or conservation professionals actually conducted more outreach, the low reporting of professionals by the interviewees conducting outreach indicates there is more scope for their involvement. Indeed, the role of non-governmental organizations in Chinese civil society is small compared to other countries with more developed conservation sectors, but environmental groups are nonetheless growing (Lu, 2007; Schwartz & Schwartz, 2004). In the future, they may be able to play more significant roles in working with the public from community-based conservation to citizen science initiatives, and could be modeled after successful examples of conservation NGO-local community partnerships within China (Shen & Tan, 2012). Situating my findings within the national context thus highlights the importance of relationships, especially power dynamics, between local communities and other actors in conservation.

The conservation-related messages reported by local communities in Hainan may reflect the cultural and historical context of public campaigns in China. While many people mentioned the common expression ‘everyone is responsible’ (‘*renren youze’*) when referring to conservation responsibility (Chapter 4), there is little indication of awareness of any concrete opportunities to participate in conservation besides complying with reserve regulations. Public campaigns and

slogans are ubiquitous and have deeply rooted roles in disseminating information and promoting ideologies in China (Karmazin, 2020). However, while the use of slogans is familiar to people and slogans are successful at altering culture and thought processes in China, their content is usually abstract and vague (Karmazin, 2020). In contrast, conservation messaging research shows that increasing direct connection to political, social, and economic issues elicits stronger perceived importance of issues, especially when tailored to the target audience's backgrounds (Giannetta, 2018; Green et al., 2019). Additionally, providing concrete content, such as quantitative information and specific recommended actions, have been shown to be more effective in promoting pro-conservation behaviors (Sun et al., 2018). Therefore, evidence from Hainan identifies shortfalls in current conservation outreach, which can also be opportunities to increase the effectiveness of outreach activities by replacing abstract slogans with more specific messages that the audience can relate to.

My findings contribute empirical evidence on conservation outreach and point to opportunities for improving communication in rural communities around protected areas. Local people around nature reserves in Hainan were more aware of punishments for undertaking prohibited activities than the benefits of conservation, suggesting that some level of fear is associated with the management of the reserve (Chapter 3). In contrast, in climate change impacts and public health campaigns, positive messages focusing on gains rather than losses were more constructive and effective (Dickinson et al., 2013; Gagnon et al., 2010; Morton et al., 2011). People expressed more interest in changing their behaviors when presented with the benefits from collective action rather than dangers and fear. Nonetheless, while some evidence suggests that promoting love rather than loss in conservation messaging is more effective, there is still debate on the broad strategies of conservation outreach (Jacobson et al., 2019; Kidd et al., 2019). Generally, conservation messaging has been shown to be more effective by leveraging social norms, focusing on issues that matter to the audience, and carefully selecting the medium and messenger through which to deliver the messages (Kusmanoff et al., 2020), although such studies have largely been conducted in western societies and may not always be transferrable to different sociocultural contexts. Nonetheless, based on my research in Hainan, the medium through which the messages are communicated through left a prominent impact on the audience, which future research investigating conservation outreach effectiveness should take into account (Chapter 6). Moreover, novel research is increasingly used to transfer lessons and theories from other sectors, such as marketing, education, and communication, to conservation outreach (Greenfield & Veríssimo, 2019; Thomas et al., 2019).

Based on new understanding of local peoples' awareness of threatened and traded wildlife in Hainan, adoption of a flagship fleet of native species could be a viable strategy for raising awareness of overall biodiversity. Flagship species and flagship fleets can be tools for communicating conservation messages through their charisma and symbolism, and for rallying support and action by acting as mascots for fundraising (Veríssimo et al., 2014). Since conservation resources are often limited, flagship fleets provide opportunities to raise awareness of multiple species that occur in the same ecosystems. Currently around BNNR, high salience species are either highly biologically or economically distinct (Hainan gibbon, golden coin turtle, big headed turtle) or relatively common (wild boar, macaque), while many other threatened native species of conservation interest are poorly known (Chapter 6). Developing a flagship fleet for Hainan can thus be a viable way to conduct future conservation outreach—building on the existing familiarity of better-known species to raise the profile of lesser-known species. Emphasizing the conservation importance and cultural values of exploited species, instead of monetary value, could reduce the risks of unintentionally stimulating trade of rare species (Ge, 2016). Together, my conclusions further support the recommendation that selecting flagship species requires a baseline understanding of perceptions and demographic characteristics of the target audience in addition to general guidelines based on characteristics of the species (Verissimo et al., 2011). Overall, my findings about local awareness of conservation relevant issues and priority protected species point to the universal need for robust baselines on which to build more effective conservation interventions.

4. RECOMMENDATIONS FOR HAINAN

Based on the findings of this thesis, the following recommendations can be made for the protected area- local community mosaic landscape in Hainan to support more inclusive and evidence-based conservation. These recommendations may be of use to researchers, governmental authorities, non-governmental organizations, and funding bodies to help shape the course of conservation in the future. While centered on the goals and vision of ZSL's Hainan Gibbon Project, I hope the insights that have emerged from this thesis are applicable to other conservation contexts in China and beyond.

1. Build trust to strengthen community engagement in conservation. Involving local people from the start of project development is key to building trust between the communities and other conservation actors, including understanding local perspectives about wildlife,

resources, and relationships with the environment. More involvement of nongovernmental conservation organizations, nature-based recreational groups (e.g. birdwatching and photography clubs), and students (e.g. local university student clubs or environmental education programs) would help build trust and transmit community perspectives to government authorities, while also reducing the workload of already limited reserve staff capacity. Formal mechanisms for local people to communicate their views, concerns, and suggestions should be in place within the management structure of Hainan's new national park, and allow for the flow of knowledge and opinions between various groups and levels of governance.

2. Robust ecological research is needed to triangulate local ecological knowledge. For example, reconstructing the spatial and temporal patterns of past environmental change, such as forest and land cover change, can benefit from a combination of field surveys, remote sensing, and accounts of knowledgeable community members and forestry staff. Local perceptions could then be cross validated with other types of data to detect biases and inaccuracies. For species highly threatened by direct exploitation, biological surveys in the wild should be conducted in combination with trade research to infer causal effect between the status of wild populations and drivers of decline. In the absence of robust biological data, monitoring markets, both physical and online, will be crucial to interpreting the patterns found in local community surveys. Recognizing the value of combining different forms of evidence to answer key questions would greatly strengthen conservation decision-making in Hainan.
3. Rapid assessments in communities around other protected areas could be conducted prior to beginning community-based conservation. Baselines on ecological knowledge, perceptions, and attitudes can be gathered along with demographic and socioeconomic data. This information would then be readily used in conservation action planning and fundraising to maximize the presence of local community perspectives. Importantly, local communities should not be treated as a homogenous entity but rather a collection of diverse views and attitudes. Therefore, conservation decisions should seek the input from many people instead of relying on few representatives to capture the diversity in the human dimensions. Comparisons between sites are especially needed to determine the transferability of management practices.
4. Conservation outreach about Hainan's native biodiversity could be integrated into school curricula, nature-based tourist attractions, and public spaces, in both rural areas and in urban centers. A flagship fleet approach could be taken to increase the awareness of

lesser-known native species and their conservation value, while taking advantage of preexisting awareness of relatively well-known species (e.g. the Hainan gibbon). Building a holistic understanding of the forest habitat, rather than taking the current single-species approach, would promote the conservation of intact ecosystems. Focusing on intrinsic rather than utilitarian values of wildlife could also contribute to attitudinal shifts from exploitation towards conservation.

5. Cultural heritage, including language, folklore, belief systems and arts should also be safeguarded to reduce erosion of traditions. However, the portrayal of ethnic minority cultures should involve input from local people to be authentic and to avoid cultural stereotypes. Because Hainan is a popular domestic tourist destination in China, the perceptions and behaviors of tourists will also have significant impacts on Hainan's environment and warrant further study. Both the choice of message and medium of conservation outreach are important, and communicating the benefits, rather than costs of conservation will be more constructive.
6. The involvement of interdisciplinary research groups will be key to building comprehensive evidence bases required for effective conservation management. Importantly, acknowledgement of the limitations of different research methods, both in natural and social sciences, would help researchers and practitioners be more open minded about including other world views and perspectives in their work. Increased collaboration between social sciences in various disciplines could therefore help ensure conservation measures will achieve the intended objectives, and should be actively encouraged by the Hainan Tropical Rainforest National Park Research Institute.

5. BEYOND HAINAN: FURTHER RESEARCH QUESTIONS

Research for this thesis contributes to the much-needed conservation evidence base in Hainan and to conservation science globally. Questions investigated in this thesis would be especially valuable to pose in environments where threatened biodiversity coexist with high human pressures, and baselines of social data are missing. Comparisons between Hainan, elsewhere in China, and other regional and global cases would be enlightening. Additionally, findings from this thesis identify further areas of research that are not only relevant to conservation in Hainan but are also transferrable to others similar systems, and contribute more generally to conservation science and practice.

My study indicates that local perceptions of wildlife, biodiversity loss, and anthropogenic threats can provide insightful information for conservation and are especially important for site-specific conservation projects. However, as societies are increasingly connected both physically and digitally, neither do communities' nor individual's perceptions exist in a vacuum. To what extent are local people's perceptions shaped by personal experiences within the community, versus drivers at the regional, national, and global level (e.g. impacts from tourism, markets, media, social media, political agendas, etc.)? In other words, what are the determinants of knowledge, awareness, and attitudes at other scales beyond the local community level? For example, how does the knowledge and perceptions of other actors in the wildlife trade compare to that of local communities, and how does it in turn affect the supply and demand of traded species—how well do sellers and consumers of wildlife know the conservation status, legal protection status, and identity of species they are trading? Further exploring these complexities around environmental perceptions would help link local patterns to global issues.

The local communities involved in my study have experienced many changes in their local environment, which are reflected in their perceptions and knowledge of wildlife decline. Against the broader trends of the global loss of local and traditional ecological knowledge, it would be valuable to further explore the complex relationship between environmental change and ecological knowledge. Does recent environmental history predict patterns of change in ecological knowledge? How long does it take for the salience of these species to be eroded and eliminated from collective memory? For example, what factors sustain the high salience of economically valuable species (e.g. the golden coin turtle), even if wild populations have disappeared long ago and local people are now unlikely to be participating in its harvest and trade? Taking a longer-term perspective by considering local and regional environmental history, such as the patterns and drivers of wildlife exploitation in the past, could help place current conservation challenges in context and guide strategies for intervention.

Furthermore, in response to the widely documented erosion of ecological knowledge, ways to reverse such loss of knowledge and sociocultural diversity that supports it amidst continuing biodiversity loss will be urgently needed. How can still existing but rapidly diminishing knowledge be rescued and preserved? Specifically, how can local communities' experiential knowledge of the environment be maintained in cases where they are excluded from interacting with natural ecosystems, e.g. where access is prohibited in strict protected areas? Considering the tremendous value that ecological knowledge contributes to conservation, these questions would be useful for both academic research and practical conservation.

6. CONCLUSION

Drawing on the environmental perceptions of people living around Hainan's key protected areas, this thesis demonstrated that local people's ecological knowledge, understandings of wildlife extinction, and responses and attitudes towards conservation management contribute important evidence to conservation. For the Zoological Society of London's Hainan Gibbon Project, local perceptions provided more holistic understanding of multi-faceted topics of conservation importance, including wildlife trade and protected area access. Overall, research in this thesis point to both the complexity in local peoples' relationships with wildlife and conservation, and value of embracing diverse perspectives. Furthermore, interviewing local people is not only a means to gather information but also a way to acknowledge the perspectives and needs of the individuals affecting, and affected by, the processes and outcomes of conservation. It is through this process of dialogue that pathways to increase inclusivity and fairness in conservation can be formed. Ultimately, engaging with the local experience is essential if conservation also strives to improve human wellbeing and achieve sustainable development alongside achieving conservation objectives. Tangible and meaningful benefits for local communities must be made possible from conservation outcomes to secure the sustained support of people who share the environment with species and habitats of conservation priority. Lessons learned from this research, while embedded in the local context and limited in scale and scope, nonetheless provide insights relevant to conservation settings beyond Hainan and China.

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APPENDICES

QUESTIONNAIRE 1 in English followed by Chinese

Date: _____Interviewer: _____
Protected area: _____Town / village: _____

We are researchers from the Zoological Society of London. We want to know more about the environment and the forests around here, so I hope you can provide some information to help us better understand the local plants and animals, and any environmental changes that have taken place. The survey is anonymous and all the information you provide will only be used for research and analysis – we will not disclose any of your details to a third party.

1. Are you willing to participate in this survey? Yes □ Unwilling □

I hope you can try to answer all the questions because this survey is very important.
2. Age_____ 3. Gender_____ 4. Ethnicity _____ 5. Occupation _____

We will now show you some photos of animals to look at. If you know or don't know what they are, either answer is fine.

6. (Wild pig photo) Do you know what this animal is? Know / do not know
Know the name _____ size / diet / appearance
_____
If do not know, ask whether they have heard of this species and its features, and if they know the characteristics of this species, then continue to ask the following question
_____
7. Have you seen these animals in the forest? Yes / No
If yes, the last time seen _____ and the place
_____
If seen, the total number of sightings _____and frequency of sightings_____
If no, then how do you know about this animal?
_____
8. Do you think this animal is now: none / rare / not many / many

9. (Macaque photo) Do you know what this animal is? Know / do not know
Know the name _____ size / diet / appearance
_____
If do not know, ask whether they have heard of this species and its features, and if they know the characteristics of this species, then continue to ask the following question
_____
10. Have you seen these animals in the forest? Yes / No
If yes, the last time seen _____ and the place
_____
If seen, the total number of sightings _____and frequency of sightings _____
If no, then how do you know about this animal?
_____
11. Do you think this animal is now: none / rare / not many / many

12. (Gibbon photo) Do you know what this animal is? Know / do not know
Know the name _____ size / diet / appearance
_____
If do not know, ask whether they have heard of this species and its features, and if they know the characteristics of this species, then continue to ask the following question
_____
13. Have you seen these animals in the forest? Yes / No
If yes, the last time seen _____ and the place _____
If seen, the total number of sightings _____ and frequency of sightings _____
If no, then how do you know about this animal?
_____
14. Have you heard any stories about gibbons or anything else about them, such as uses?
_____
_____
15. Do you know any characteristics of gibbons (ecology, reproduction, behaviour, food)?
_____
____
16. Do you know if other people have seen gibbons (time, place_____
Please provide the person's contact information
_____
17. Do you know someone who has heard gibbons (time, place)?
_____
18. Do you think this animal is now: none / rare / not many / many
19. Do you know anyone in the local area who has seen a gibbon within the past 10-15 years?
If yes, who _____ location and any other information
_____
* Can you take me to them, or call them?

20. (Clouded leopard photo) Do you know what this animal is? Know / do not know
Know the name _____ size / diet / appearance
_____
If do not know, ask whether they have heard of this species and its features, and if they know the characteristics of this species, then continue to ask the following question

21. Have you seen these animals in the forest? Yes / No
If yes, the last time seen _____ and the place _____
If seen, the total number of sightings _____and frequency of sightings _____
If no, then how do you know about this animal?
_____
22. Do you think this animal is now: none / rare / not many / many

23. (Bear photo) Do you know what this animal is? Know / do not know
Know the name _____ size / diet / appearance
_____
If do not know, ask whether they have heard of this species and its features, and if they know the characteristics of this species, then continue to ask the following question
_____
24. Have you seen these animals in the forest? Yes / No
If yes, the last time seen _____and the place _____

If seen, the total number of sightings _____ and frequency of sightings_____
If no, then how do you know about this animal?
_____
25. Have you seen tracks/traces of a bear in the forest? (scratches, faeces, footprints, etc.) Yes / No
If yes, where, trail description, why do you think it was a bear, time, place
_____
26. Do you think this animal is now: none / rare / not many / many

27. (Pangolin photo) Do you know what this animal is? Know / do not know
Know the name _____ size / diet / appearance
_____
If do not know, ask whether they have heard of this species and its features, and if they know the characteristics of this species, then continue to ask the following question

28. Have you seen these animals in the forest? Yes / No
If yes, the last time seen _____and the place
_____
If seen, the total number of sightings _____and frequency of sightings
_____
If no, then how do you know about this animal?
_____
29. Do you think this animal is now: none / rare / not many / many
30. Has anyone poached pangolins? Yes / No
Are they local or foreign? Local / foreign
Was it for local use or to sell elsewhere? Local / foreign Place
_____
31. Has the poaching frequency changed? Yes / No
If yes, how / when / why the change?
_____

32. (Binturong photo) Do you know what this animal is? Know / do not know
Know the name _____ size / diet / appearance
_____
If do not know, ask whether they have heard of this species and its features, and if they know the characteristics of this species, then continue to ask the following question

33. Have you seen these animals in the forest? Yes / No
If yes, the last time seen _____ and the place
_____
If seen, the total number of sightings _____ and frequency of sightings
_____
If no, then how do you know about this animal?
_____
34. Do you think this animal is now: none / rare / not many / many

35. (Sambar photo) Do you know what this animal is? Know / do not know
Know the name _____ size / diet / appearance
_____
If do not know, ask whether they have heard of this species and its features, and if they know the characteristics of this species, then continue to ask the following question

36. Have you seen these animals in the forest? Yes / No
If yes, the last time seen _____and the place
_____
If seen, the total number of sightings _____and frequency of sightings
_____
If no, then how do you know about this animal?
_____
37. Do you think this animal is now: none / rare / not many / many

38. (Giant anteater photo) Do you know what this animal is? Know / do not know
Know the name _____ size / diet / appearance
_____
If do not know, ask whether they have heard of this species and its features, and if they know the characteristics of this species, then continue to ask the following question

39. Have you seen these animals in the forest? Yes / No
If yes, the last time seen _____and the place
_____
If seen, the total number of sightings _____and frequency of sightings
_____
If no, then how do you know about this animal?
_____
40. Do you think this animal is now: none / rare / not many / many

41. Do you think the number of any of these animals has decreased? Yes / No
If yes, which animals, reduced by how much?
_____
42. Have any other animals around here also decreased in number?
_____
43. What do you think is the rarest animal around here?
_____
44. Have any animals around here not decreased in number?
_____
45. In addition to these animals, are there any animals that used to occur around here in the past but have now disappeared? Yes/ No
If yes, describe the animals, time and place seen or other source of news, and when they disappeared
_____
____
46. Have you heard from elderly people that any other types of animals used to occur around here, but disappeared long ago?
_____
47. Have you always lived in this village? Yes / No
If No, where did you live before?
_____
48. How often do you go into the forest (monthly or weekly)?
_____
If you no longer enter the forest, what is the reason?
_____

What would you like to be allowed to do in the forest?
_____
49. Where do you usually go to get wood (area and distance)?
_____
50. Did you used to go into the forest more in the past (time and frequency)?
_____
51. How much of your income comes from things collected in the forest?
_____

(Play five kinds of animal sounds)
52. Chimpanzee (____): Have you heard it? Yes/ rarely / not many / many / none
Name? _____
How many times? _____ When? _____ Place?
_____
53. Gibbon (____): Have you heard it? Yes/ rarely / not many / many / none
Name? _____
How many times? _____ When? _____ Place?
_____
54. Peafowl (____): Have you heard it? Yes/ rarely / not many / many / none
Name? _____
How many times? _____ When? _____ Place?
_____
55. Howler monkey (____): Have you heard it? Yes/ rarely / not many / many / none
Name? _____
How many times? _____ When? _____ Place?
_____
56. Screaming piha (____): Have you heard it? Yes/ rarely / not many / many / none
Name? _____
How many times? _____ When? _____ Place?
_____

Do you know anyone in the village who is familiar with the wild animals here? Can you help us find them?

海南野生动物社区调查问卷

日期:_____ 调查员: _____
保护区: _____乡/村: _____

我们是伦敦动物学会的调查员。我们想要多了解这里周围的环境与林子，所以希望你能提供一些相关信息，帮助我们更了解以前山上的动植物以及多年来的环境变迁。这个是个不记名调查，你提供的所有信息只会被用作研究分析，不会向第三方透露。

1. 你是否愿意参与这次问卷调查？ 愿意 □ 不愿意 □
希望你可以尽量回答我们这份卷子的所有问题，这个对我们调查非常重要。
2. 年龄_____ 3. 性别_____ 4. 民族_____ 5. 职业_____

现在给你们看一些动物的照片，看你们认不认识，不认识也没有关系。

6. （wild pig photo）你知道这是什么动物吗？ 知道 / 不知道
知道，名称_____大小/食性/外貌_____
不知道，问是否有听说过这物种以及它的特征，如果知道物种特征，继续问以下问题
_____
7. 你在山上见过这动物吗? 有 / 没有
有，上次看见的时间_____地点_____
看见总次数_____如果常见，频率是_____
没有，你是如何知道这动物的？_____
8. 你觉得这个动物现在是 没有 / 很少 / 不多 / 很多

9. （macaque photo）你知道这是什么动物吗？ 知道 / 不知道
知道，名称_____大小/食性/外貌
_____
不知道，问是否有听说过这物种以及它的特征，如果知道物种特征，继续问以下问题
_____
____
10. 你在山上见过这动物吗? 有 / 没有
有，上次看见的时间_____地点_____
看见总次数_____如果常见，频率是_____
没有，你是如何知道这动物的？_____
11. 你觉得这个动物现在是 没有 / 很少 / 不多 / 很多

12. （gibbon photo）你知道这是什么动物吗？ 知道 / 不知道
知道，名称_____大小/食性/外貌_____
不知道，问是否有听说过这物种以及它的特征，如果知道物种特征，继续问以下问题
13. 你在山上见过这动物吗? 有 / 没有
有，上次看见的时间_____地点_____
看见总次数_____如果常见，频率是_____
没有，你是如何知道这动物的?
_____

14. 你听说过有关长臂猿的故事或事情（如用途）吗?

_____

15. 你知道长臂猿的特征吗（生态、繁殖、行为、食物）？_____

16. 你知道其他人在山上见过这动物吗（时间、地点）？_____

可否提供这个人的联系方式?

_____

17. 你知道有人打过长臂猿吗（时间、地点）？

_____

18. 你觉得这个动物现在是 没有 / 很少 / 不多 / 很多

19. 你可知道附近有人在近 10-15 年内有见过长臂猿吗?

有，谁_____什么时候_____地点_____其它信息

_____

*问是否能带我去找他或打给他?

20. （clouded leopard photo）你知道这是什么动物吗? 知道 / 不知道

知道，名称_____大小/食性/外貌

_____

不知道，问是否有听说过这物种以及它的特征，如果知道物种特征，继续问以下问题

21. 你在山上见过这动物吗? 有 / 没有

有，上次看见的时间_____地点_____

看见总次数_____如果常见，频率是

_____

没有，你是如何知道这动物的?

_____

22. 你觉得这个动物现在是 没有 / 很少 / 不多 / 很多

23. （bear photo）你知道这是什么动物吗? 知道 / 不知道

知道，名称_____大小/食性/外貌

_____

不知道，问是否有听说过这物种以及它的特征，如果知道物种特征，继续问以下问题

24. 你在山上见过这动物吗? 有 / 没有

有，上次看见的时间_____地点_____

看见总次数_____如果常见，频率是_____

没有，你是如何知道这动物的?

_____

25. 你有没有在山上发现过熊留下的踪迹（抓痕、粪便、脚印等） 有 / 没有

有，踪迹的描述、为什么认为是熊的、时间、地点

_____

26. 你觉得这个动物现在是 没有 / 很少 / 不多 / 很多

27. （pangolin photo）你知道这是什么动物吗? 知道 / 不知道

知道，名称_____大小/食性/外貌

_____

问是否有听说过这物种以及它的特征，如果知道物种特征，继续问以下问题

_____

28. 你在山上见过这动物吗？ 有 / 没有

有，上次看见的时间_____地点_____

看见总次数_____如果常见，频率是

_____

没有，你是如何知道这动物的？_____

29. 你觉得这个动物现在是 没有 / 很少 / 不多 / 很多

30. 这里有人抓穿山甲么？有 / 没有

有，当地还是外来人？ 当地 / 外来

当地使用还是卖到外地？ 当地 / 外地，地方

_____

31. 捕猎频率有改变吗？ 有 / 没有 有，怎么/什么时候/为什么改变？

_____

32. （binturong photo）你知道这是什么动物吗？ 知道 / 不知道

知道，名称_____大小/食性/外貌

_____

不知道，问是否有听说过这物种以及它的特征，如果知道物种特征，继续问以下问题

33. 你在山上见过这动物吗？ 有 / 没有

有，上次看见的时间_____地点_____

看见总次数_____如果常见，频率是_____

没有，你是如何知道这动物的？

_____

34. 你觉得这个动物现在是 没有 / 很少 / 不多 / 很多

35.（sambar photo）你知道这是什么动物吗？ 知道 / 不知道

知道，名称_____大小/食性/外貌_____

不知道，问是否有听说过这物种以及它的特征，如果知道物种特征，继续问以下问题

36. 你在山上见过这动物吗？ 有 / 没有

有，上次看见的时间_____地点_____

看见总次数_____如果常见，频率是_____

没有，你是如何知道这动物的？

_____

37. 你觉得这个动物现在是 没有 / 很少 / 不多 / 很多

38. （giant anteater photo）你知道这是什么动物吗？ 知道 / 不知道

知道，名称_____大小/食性/外貌

_____

不知道，问是否有听说过这物种以及它的特征，如果知道物种特征，继续问以下问题

39. 你在山上见过这动物吗？ 有 / 没有

有，上次看见的时间_____地点_____

看见总次数_____如果常见，频率是

_____

没有，你是如何知道这动物的?

_____

40. 你觉得这个动物现在是 没有 / 很少 / 不多 / 很多

41. 你觉得以上这些动物的数量在这些年有没有减少? 有 / 没有
有，什么动物，减少多少?

_____

42. 除了以上的动物，这里还有什么动物越来越少了?

_____

43. 你觉得这里现在最稀有的动物是那种?

_____

44. 你觉得那种动物数量没有减少过?

_____

45. 除了以上的动物，这里以前还有什么动物是现在没有的? 有 / 没有
有，描述动物，见到的时间和地点，或者其它消息来源，什么时候消失的?
_____ 有没有从老人听说附近有其它动物，但是在很久以前就已经消失了?
_____

47. 你是否一直住在这村子? 是 / 否，你住在这里多久_____以前住哪
_____

48. 你一般多久会进山一次（每月或每周）?

_____

如果现在已经不再上山，原因是什么?

_____

你希望能允许上山么?

_____

49. 通常会去哪片林子（片区与距离）?

_____

50. 你进山的频率以前会更高吗（时间与频率）?

_____

51. 你经济收入的多大部分来自林子采来的东西?_____

52. 第一段（____）：有听过吗? 有，很少 / 不多 / 很多/ 没有 名称
_____
几次_____时间_____地点
_____

53. 第二段（____）：有听过吗? 有，很少 / 不多 / 很多/ 没有 名称
_____
几次_____时间_____地点
_____

54. 第三段（____）：有听过吗? 有，很少 / 不多 / 很多/ 没有 名称
_____
几次_____时间_____地点
_____

55. 第四段（____）：有听过吗? 有，很少 / 不多 / 很多/ 没有 名称
_____

几次_____时间_____地点
_____

56. 第五段（____）：有听过吗？有，很少 / 不多 / 很多/ 没有 名称
_____

几次_____时间_____地点
_____

你可知道村子里有哪个人熟悉野生动物？能否协助我们找到他吗？

QUESTIONNAIRE 2 in English followed by Chinese

Hainan Wildlife Knowledge Community-Based Interview

Information for interviewees

I am a graduate student at the university (Imperial College London, UK). I am researching the wildlife around here. Could I please interview you? Here are some instructions for our interview:

- The respondent must be at least 18 years old.
- This is an anonymous interview. No personal identity information will be recorded.
- The answers you provide will only be used for scientific research and analysis purposes. No information will be disclosed to a third party.
- This survey is very important. We hope you can answer all the questions, and answer them honestly.
- You have the right to terminate the interview at any time

Thank you for your participation!

1. [Single choice] Are you willing to participate in this survey:
   ☐Yes ☐Unwilling

2. [Single choice] Are you literate:
   ☐Yes I am literate ☐Yes but not many characters ☐No I am not literate

3. [Single choice] Can you understand Mandarin?

   ☐Yes I can ☐Yes but not much ☐No I can't

4. [Single choice] Can you understand Hainanese?

   ☐Yes I can ☐Yes but not much ☐No I can't

5. How old are you? _____
6. [Single choice] What is your gender? ☐ Male ☐ Female
7. [Single choice] What is your ethnicity? ☐ Li ☐ Miao ☐ Han ☐ Don't know ☐ Other: _____
8. [Single choice] How long have you been living in this village?
   ☐ All my life ☐ Other: _____
9. If their answer is other:

   Where are you from?

   _____

   Where did you live previously?

   _____

How long have you been living there?

_____

10. Number of adults (including you) living in your house? _____
11. Number of children (under 18) living in your house? _____
12. [If have children] Do you have children attending school? ☐Yes ☐No
    If their answer is yes:
    Which year are they in?

    _____
    Do they go to school in this village? ☐Yes ☐No

    If no, which village/town do they go to school in? _____
13. What is the distance(km) between the nearest playschool to your village?
    ☐I don't know or _____
14. What is the distance(km) between the nearest elementary school to your village?

    ☐I don't know or _____
15. What is the distance(km) between the nearest middle school to your village?

    ☐I don't know or _____
16. What is the distance(km) between the nearest high school to your village?

    ☐I don't know or _____
17. [Multiple choices] Occupation:
    ☐ I don't have a job ☐ Farmer ☐ Husbandry practitioner ☐ Fisherman ☐ Teacher ☐ Student ☐ Forest worker

    ☐ Staff of the government department

    ☐ Retired ☐ Other: _____
18. Average annual household income (yuan): _____
19. [Single choice] What is your highest education level?
    ☐ No education ☐ Elementary school ☐ Middle school ☐ High school ☐ College ☐ Undergraduate ☐ Graduate degree or above

    ☐ Other: _____
20. Do you go into the forest more than once a month? ☐Yes ☐ No
21. Which animals in China are endangered? [List all species that come to mind, use prompts (e.g. are there any other animals in China which are endangered?) if necessary to make sure they have thought of as many as they can] **Write the species in the order they are mentioned**

_____

_____

22. Which animals in Hainan are endangered? [Free list all species that come to mind, use prompts (e.g. are there any other animals in Hainan which are endangered?) if necessary to make sure they have thought of as many as they can] **Write the species in the order they are mentioned**

_____

_____

23. What do you remember about the last time a conservation education event happened in your community? [Ask respondent to provide as much detail as possible but without prompting them about specifics]
☐ No conservation education has been conducted in this community

_____
_____
_____

24. [If no information is provided by the respondent to the above open-ended question, prompt them by asking about the following]:

i) When did it happen? ☐Don't know

Year _____ Month_____ Date _____ Or _____years ago

Other [describe] _____

ii) Who came to speak to you? ☐Don't know

☐Reserve management officials
☐Biologists
☐Village or community leader
☐Forest Police
☐Local governmental officials
☐ Mainland Chinese NGO
☐ Hong Kong/Macau/Taiwan NGO
☐ International NGO
☐ University students
☐ Other: _____

iii) What topics did they speak to you about? ☐Don't know

☐ It is prohibited to cut down trees
☐ It is prohibited to collect firewood
☐ It is prohibited to set fires inside or near the forest
☐ Where the boundaries of the reserve are drawn
☐ It is prohibited to hunt, trap, or catch wild animals
List species mentioned _____
☐ What NTFPs are/aren't allowed to be collected from within the reserve
List species mentioned (and if can/cannot collect)_____
_____
☐ Where villagers are/aren't allowed to go inside the reserve
☐ What species of animals are found here

List species mentioned _____

☐ What species of animals are protected

List species mentioned _____

☐ It is prohibited to graze cattle in the forest

☐ Other:_____

iv) How did they communicate with you? ☐Don't know

☐Showed film

☐Handed out pamphlets and printed materials

☐Gave presentation about species

☐Spoke to people door to door

☐ Gathered people for a group meeting

☐ Spoke to village headman and asked him to disperse message to members of the community

☐ Broadcast message from vehicle with loudspeaker

☐Other:_____

v) What were you told would happen if local people followed the conservation policies made for managing Bawangling National Nature Reserve?

☐ Don't know

☐ None

☐ Become poorer

☐ Future generations will never see the forest or know what's in it

☐ Have less natural resources to use

☐ Restoration of the forest ecosystem and local environment

☐ Improved livelihoods

☐ Monetary compensation

☐ Children and grandchildren will be able to use the resources later

☐ Other:_____

25. Have there been any other conservation education events that have happened in your community? What do you remember about these events? [Ask respondent to provide as much detail as possible but without prompting them about specifics]

_____

_____

_____

海南野生动物知识社区采访

采访说明

我是一名大学研究生（英国帝国理工大学）。我在通过社区采访的形式研究这里的野生动物。请问我可不可以采访一下您？以下是我采访的一些说明：

- 受访者需年满 18 周岁
- 这个是个不记名调查，我们不会记录您任何的个人身份信息
- 您提供的所有信息只会被用作在帝国理工大学以及伦敦皇家霍洛威大学的科学研究分析，不会向任何第三方透露
- 这份采访非常重要，我们希望您可以诚实地回答我们这份卷子的所有问题
- 采访过程中您有权随时终止采访

非常感谢您的参与！

1 [单选题] 您是否愿意接受此次采访？

• 愿意 | • 不愿意

2 ［单选题］请问您是否识字呢？

•是的，我识字 | •是的，但是我认识的字不多 | •不，我不识字

3 ［单选题］请问您是否能听懂普通话？

•是的，我可以 |•是的，但是我能听懂的不多 | •不，我听不懂

4 ［单选题］请问您是否能听懂海南话？

•是的，我可以 |•是的，但是我能听懂的不多 | •不，我听不懂

5 请问您的年龄是？_____

6 [单选题] 请问您的性别是？

• 男 | • 女

7 [单选题] 请问您的民族是？

•黎族 | •苗族| •汉族 | • 我不知道| • 其它：_____

8 [单选题] 请问您在这个村子（村名）中生活了多长时间？

•从出生就住在这里 | • 其它：_____

9.a) 您是哪里人呢？ / 籍贯哪里呢？

•海南人 | • 其他：_____

9.b) 之前生活在哪里呢？_____

9.c) 在那里生活了多久呢？_____

•之前一直在那里

10 请问和您住在一起的包括您有几个大人（年龄大于 18 岁）？

• 1 | • 2 | • 3 | • 4 | • 5 | • 6 | • 7| • 8 | • 9 | • 10

11 请问现在和您住在一起的有几个孩子（年龄小于 18 岁）？

• 0 | • 1 | • 2 | • 3 | • 4 | • 5 | • 6 | • 7| • 8 | • 9 | • 10

12 [单选题] 您的小孩正在上学吗？

• 是 | • 不是

12.a) 他们上几年级了呢？

小学一年级丨小学二年级丨小学三年级丨小学四年级丨小学五年级

小学六年级丨初一丨初二丨初三丨高一丨高二丨高三 丨 幼儿园

大专丨中专丨大学丨研究生

12.b) [单选题] 他们在这个村子里（村名）上学吗？

• 是 | • 不是

12.d) 他们在哪里上学呢？

七叉镇丨霸王镇丨石碌丨昌江

13 [单选题] 请问最近的幼儿园离村子（村名）有多远呢(公里)？

• 我不知道| 七叉镇丨霸王镇

14 [单选题] 请问最近的小学离村子（村名）有多远呢(公里)？

• 我不知道|七叉镇丨霸王镇

15 [单选题] 请问最近的初中离村子（村名）有多远呢(公里)？

• 我不知道| 霸王镇丨七叉镇

16 [单选题] 请问最近的高中离村子（村名）有多远呢（公里）？

• 我不知道| 石碌，昌江

17 [多选题] 请问您的职业是？_____

• 无业 | • 农民

18 请问您的家庭年收入是多少元呢？_____

19 [单选题] 请问您上过学吗？

• 无教育经历 | • 小学 | • 初中 | • 高中丨中专丨大学丨大专

20 [单选题] 请问您每个月至少会上山一次吗？

• 是 | • 不是

任何评论？ _____

21 您认为中国有哪些濒危动物？

•我不知道

_____

_____

22 您认为海南有哪些濒危动物？

•我不知道

_____

_____

23 [单选题] 请问您记得最近一次来村子里讲解关于保护环境和野生动物的人说了些什么吗？

在不提醒的情况下，请受访者尽可能提供所有能想到的细节

•这里从未有过保护宣传教育活动

• 有

_____

_____

_____

【在上述开放性问题之后，提示性提问问题】

24.a) [单选题] 他们什么时候来过呢？

• 我不知道| • 不记得了 丨

24.b) [多选题] 谁来和您讲的？

• 我不知道丨不记得了

•霸王岭保护区的人丨林业局的人 丨•森林公安丨护林员

•村子或社区领导

•当地政府官员

•嘉道理丨•大学生

34.c) [多选题] 他们和您讨论了那些话题？

• 我不知道 丨不记得了

•不让上山了丨•不允许砍伐树木

•森林防火丨不让烧山

•不准打动物丨山猪，山马，野猪，猴子

•保护动物

24.d) [多选题] 他们怎样和您交流、传达信息的？

• 我不知道

•贴广告丨发传单

•放映影片

•上门和住户单独谈话丨•召开集体会议

• 和村长交流后由村长向社区居民转达

•用车上的喇叭广播

24.e) [多选题] 他们有没有和您讲过遵守霸王岭保护区的保护政策会带来什么？

• 我不知道丨不记得了

• 没有

25 除了上述的内容，在您的社区还开展过哪些保护宣传教育活动？

•没有

_____

_____

QUESTIONNAIRE 3 in English followed by Chinese

Questionnaire ID: _____ Date: _____ Village name: _____ Interviewer: _____

We are Hainan University students and we are conducting research on the environment. This is very important and we hope you can help us by answering the questions in this questionnaire truthfully. The interview will take about 40 minutes to complete. Your answer will be anonymous and you cannot be identified after the data is collected. You must be at least 18 years old to participate. You can choose to stop the interview at any time. You may contact the researchers at any time for more information. Heidi Ma, Royal Holloway University of London. Contact phone number: 13910971742, Wechat: heidima0825.

Are you willing to participate in this survey: ☐Yes ☐No

SECTION 1 DEMOGRAPHIC

1. Have you been interviewed before? ☐Yes ☐No
   Who came to speak with you? _____
   What did they ask you about? _____
2. How old are you? _____
3. What is your gender? ☐ Male ☐ Female
4. What is your ethnicity? ☐ Li ☐ Miao ☐ Han ☐ Other: _____
5. Are you literate?
   ☐Yes I am literate ☐Yes but not many characters ☐No I am not literate
6. Which languages can you understand?
   ☐Li language ☐Miao language ☐Standard Mandarin
   ☐Hainanese ☐Other _____
7. How long have you been living in this village?
   ☐ All my life ☐ Other: _____
   If their answer is other: Where are you from? _____
   Where did you live previously? _____
   How long have you been living here?
   _____
8. How many of your children are living with you in your house? _____
   How old are they? _____
   Other than your children, how many people live in your house (not including yourself)?
   _____
   What are their relationships to you?
   _____
9. [Multiple choices] Occupation:
   ☐ I don't have a job ☐ Farmer ☐ Husbandry practitioner ☐ Teacher
   ☐ Student ☐ Forestry worker ☐ Government worker
   ☐ Retired For how many years? _____ ☐ Other: _____
10. Total annual household income (yuan): _____
11. What is your highest education level?
    ☐ No education ☐ Elementary school ☐ Middle school ☐ High school
    ☐ College ☐ Undergraduate ☐ Graduate degree or above
    ☐ Other: _____

SECTION 2 ACCESS TO RESOURCES

1. How often do you go into the forest/reserve? _____
   Do you go into the forest more than once a month? ☐Yes ☐ No
2. What do you do when you go into the forest? (Including in the past)
   _____
3. What things in the forest have use value to you? _____
   _____

   How often do you collect these things?
   Resource 1 _____ ☐Daily ☐Weekly ☐Monthly ☐Yearly
   Resource 2 _____ ☐Daily ☐Weekly ☐Monthly ☐Yearly
   Resource 3 _____ ☐Daily ☐Weekly ☐Monthly ☐Yearly

4. How often do you go to the nearest county town? _____
   Do you go Shilu more than once a month? ☐Yes ☐ No
5. What do you go to the county town for?
   ☐ Hospital/clinic ☐ Buying goods (describe) _____
   ☐ Taking children to school ☐ Banking ☐ Post office ☐ Other _____
6. How much does it cost you per return trip to Shilu town? _____yuan
7. How to you get to the county town? _____
8. Where do you go for these things/services if it's not available in the county town?
   _____

SECTION 3 WILDLIFE KNOWLEDGE

1. a. Has the ***overall abundance of wildlife*** changed in the time you have lived here?
   ☐Increased ☐ Decreased ☐ No change ☐Don't know
   [If answered "Increased" or "Decreased", ask the following questions. If answered "No change" or "Don't know", skip to next Q2.]
   b. When did the overall abundance of wildlife change? _____years ago ☐Don't know
   c. In what areas have you noticed changes in wildlife abundance? _____ ☐Don't know
   d. How do you know there is this change? _____ ☐Don't know
   e. Does your knowledge about the change in overall abundance of wildlife come from your elders such as your parents? _____ ☐Don't know

2. Are there any species of wildlife that have ***declined*** in abundance in the time you have lived here? ☐ Yes ☐ No ☐ Don't know
   Freelist and provide details for each species listed:

Species	When declined

3. Are there any species of wildlife that have *completely disappeared* from around here in the time you have lived here? ☐ Yes ☐ No ☐ Don't know
Freelist and provide details for each species:

Species	When disappeared

4. a. Do you think it is possible that animals could disappear and never appear again?
☐Yes ☐ No ☐Don't know
b. What is "extinction"? OR What does "extinction" mean to you?
_____ ☐Don't know
c. What do you know about "extinction" from elders/your parents?
_____ ☐Don't know
d. What do you know about "extinction" from the media (TV, internet, Wechat)?
_____ ☐Don't know
e. What do you know about "extinction" from other visitors to your village?
_____ ☐Don't know
f. Do you know about extinction from any other sources?
_____

5. Which turtle species are found around Bawangling? [Free-list turtles, record in order they listed the species].
_____
_____
_____
_____

[For all species in Q6-Q16, show photos one by one]

6. [Sacalia quadriocellata, 四眼斑龟, 臭龟, Four-eyed Turtle]
   a. Do you recognize this species? ☐ Yes ☐ No ☐ Don't know
   [If answer is Don't Know, skip following questions about this species.]
   b. What is its name? _____ ☐ Don't know
   Have you seen this species before? ☐ Yes ☐ No ☐ Don't know
   c. Where did you last see it physically? _____(place)
   ☐ In the forest ☐ In the village ☐ In the market ☐ In someone else's house
   ☐ In a zoo ☐ Other _____
   d. When did you last see it? _____ (time)
   e. Is this species still found in the wild in this area? ☐ Yes ☐ No ☐ Don't know
   f. If no, did it used to be found here? ☐ Yes ☐ No ☐ Don't know

g. Is this species rare or common? ☐ Many ☐ Not many ☐ Rare ☐ None ☐ Don't know
h. Where does this species live? ☐ In water ☐ In the forest ☐ Don't know ☐ Other/details _____
i. Is this species sold? ☐ Yes ☐ No ☐ Don't know

7. [Cuora mouhotii 锯缘龟, 八角龟 Keeled Box Turtle]
   a. Do you recognize this species? ☐ Yes ☐ No ☐ Don't know
   [If answer is Don't Know, skip following questions about this species.]
   b. What is its name? _____ ☐ Don't know
   Have you seen this species before? ☐ Yes ☐ No ☐ Don't know
   c. Where did you last see it physically? _____(place)
   ☐ In the forest ☐ In the village ☐ In the market ☐ In someone else's house ☐ In a zoo ☐ Other _____
   d. When did you last see it? _____ (time)
   e. Is this species still found in the wild in this area? ☐ Yes ☐ No ☐ Don't know
   f. If no, did it used to be found here? ☐ Yes ☐ No ☐ Don't know
   g. Is this species rare or common? ☐ Many ☐ Not many ☐ Rare ☐ None ☐ Don't know
   h. Where does this species live? ☐ In water ☐ In the forest ☐ Don't know ☐ Other/details _____
   i. Is this species sold? ☐ Yes ☐ No ☐ Don't know

8. [Geoemyda spengleri 锯齿地龟, 小八角龟, 枫叶龟 Black-breasted Leaf Forest Turtle]
   a. Do you recognize this species? ☐ Yes ☐ No ☐ Don't know
   [If answer is Don't Know, skip following questions about this species.]
   b. What is its name? _____ ☐ Don't know
   Have you seen this species before? ☐ Yes ☐ No ☐ Don't know
   c. Where did you last see it physically? _____(place)
   ☐ In the forest ☐ In the village ☐ In the market ☐ In someone else's house ☐ In a zoo ☐ Other _____
   d. When did you last see it? _____ (time)
   e. Is this species still found in the wild in this area? ☐ Yes ☐ No ☐ Don't know
   f. If no, did it used to be found here? ☐ Yes ☐ No ☐ Don't know
   g. Is this species rare or common? ☐ Many ☐ Not many ☐ Rare ☐ None ☐ Don't know
   h. Where does this species live? ☐ In water ☐ In the forest ☐ Don't know ☐ Other/details _____
   i. Is this species sold? ☐ Yes ☐ No ☐ Don't know

9. [Mauremys mutica 材棺龟, 石龟, 黄喉泥水龟, 南石龟, 石金钱 Yellow Pond turtle]
   a. Do you recognize this species? ☐ Yes ☐ No ☐ Don't know
   [If answer is Don't Know, skip following questions about this species.]
   b. What is its name? _____ ☐ Don't know
   Have you seen this species before? ☐ Yes ☐ No ☐ Don't know
   c. Where did you last see it physically? _____(place)
   ☐ In the forest ☐ In the village ☐ In the market ☐ In someone else's house ☐ In a zoo ☐ Other _____

d. When did you last see it? _____ (time)
e. Is this species still found in the wild in this area? ☐ Yes ☐ No ☐ Don't know
f. If no, did it used to be found here? ☐ Yes ☐ No ☐ Don't know
g. Is this species rare or common? ☐ Many ☐ Not many ☐ Rare ☐ None ☐ Don't know
h. Where does this species live? ☐ In water ☐ In the forest ☐ Don't know ☐ Other/details _____
i. Is this species sold? ☐ Yes ☐ No ☐ Don't know

10. [Pelodiscus sinensis 中华鳖 Chinese Softshell Turtle]
    a. Do you recognize this species? ☐ Yes ☐ No ☐ Don't know
    [If answer is Don't Know, skip following questions about this species.]
    b. What is its name? _____ ☐ Don't know
    Have you seen this species before? ☐ Yes ☐ No ☐ Don't know
    c. Where did you last see it physically? _____(place)
    ☐ In the forest ☐ In the village ☐ In the market ☐ In someone else's house ☐ In a zoo ☐ Other _____
    d. When did you last see it? _____ (time)
    e. Is this species still found in the wild in this area? ☐ Yes ☐ No ☐ Don't know
    f. If no, did it used to be found here? ☐ Yes ☐ No ☐ Don't know
    g. Is this species rare or common? ☐ Many ☐ Not many ☐ Rare ☐ None ☐ Don't know
    h. Where does this species live? ☐ In water ☐ In the forest ☐ Don't know ☐ Other/details _____
    i. Is this species sold? ☐ Yes ☐ No ☐ Don't know

11. [Mauremys sinensis 中华花龟，海花，海南花龟 Chinese Golden Thread Turtle]
    a. Do you recognize this species? ☐ Yes ☐ No ☐ Don't know
    [If answer is Don't Know, skip following questions about this species.]
    b. What is its name? _____ ☐ Don't know
    Have you seen this species before? ☐ Yes ☐ No ☐ Don't know
    c. Where did you last see it physically? _____(place)
    ☐ In the forest ☐ In the village ☐ In the market ☐ In someone else's house ☐ In a zoo ☐ Other _____
    d. When did you last see it? _____ (time)
    e. Is this species still found in the wild in this area? ☐ Yes ☐ No ☐ Don't know
    f. If no, did it used to be found here? ☐ Yes ☐ No ☐ Don't know
    g. Is this species rare or common? ☐ Many ☐ Not many ☐ Rare ☐ None ☐ Don't know
    h. Where does this species live? ☐ In water ☐ In the forest ☐ Don't know ☐ Other/details _____
    i. Is this species sold? ☐ Yes ☐ No ☐ Don't know

12. [Cuora trifasciata 金钱龟 Golden Coin Turtle]
    a. Do you recognize this species? ☐ Yes ☐ No ☐ Don't know
    [If answer is Don't Know, skip following questions about this species.]
    b. What is its name? _____ ☐ Don't know
    Have you seen this species before? ☐ Yes ☐ No ☐ Don't know
    c. Where did you last see it physically? _____(place)

☐ In the forest ☐ In the village ☐ In the market ☐ In someone else's house
☐ In a zoo ☐ Other _____

d. When did you last see it? _____ (time)
e. Is this species still found in the wild in this area? ☐ Yes ☐ No ☐ Don't know
f. If no, did it used to be found here? ☐ Yes ☐ No ☐ Don't know
g. Is this species rare or common? ☐ Many ☐ Not many ☐ Rare ☐ None
☐ Don't know
h. Where does this species live? ☐ In water ☐ In the forest ☐ Don't know ☐
Other/details _____
i. Is this species sold? ☐ Yes ☐ No ☐ Don't know

13. [Clemmys guttata 黄斑水龟 Spotted Turtle]
    a. Do you recognize this species? ☐ Yes ☐ No ☐ Don't know
    [If answer is Don't Know, skip following questions about this species.]
    b. What is its name? _____ ☐ Don't know
    Have you seen this species before? ☐ Yes ☐ No ☐ Don't know
    c. Where did you last see it physically? _____(place)
    ☐ In the forest ☐ In the village ☐ In the market ☐ In someone else's house
    ☐ In a zoo ☐ Other _____
    d. When did you last see it? _____ (time)
    e. Is this species still found in the wild in this area? ☐ Yes ☐ No ☐ Don't know
    f. If no, did it used to be found here? ☐ Yes ☐ No ☐ Don't know
    g. Is this species rare or common? ☐ Many ☐ Not many ☐ Rare ☐ None
    ☐ Don't know
    h. Where does this species live? ☐ In water ☐ In the forest ☐ Don't know ☐
    Other/details _____
    i. Is this species sold? ☐ Yes ☐ No ☐ Don't know

14. [Cuora galbinifrons 黄额闭壳龟，黄额盒龟，草龟，山草龟，红旗龟，假金钱龟 Indochinese Box Turtle]
    a. Do you recognize this species? ☐ Yes ☐ No ☐ Don't know
    [If answer is Don't Know, skip following questions about this species.]
    b. What is its name? _____ ☐ Don't know
    Have you seen this species before? ☐ Yes ☐ No ☐ Don't know
    c. Where did you last see it physically? _____(place)
    ☐ In the forest ☐ In the village ☐ In the market ☐ In someone else's house
    ☐ In a zoo ☐ Other _____
    d. When did you last see it? _____ (time)
    e. Is this species still found in the wild in this area? ☐ Yes ☐ No ☐ Don't know
    f. If no, did it used to be found here? ☐ Yes ☐ No ☐ Don't know
    g. Is this species rare or common? ☐ Many ☐ Not many ☐ Rare ☐ None
    ☐ Don't know
    h. Where does this species live? ☐ In water ☐ In the forest ☐ Don't know ☐
    Other/details _____
    i. Is this species sold? ☐ Yes ☐ No ☐ Don't know

15. [Palea steindachneri 疣颈龟，山瑞鳖 Wattle-necked Softshell Turtle]
    a. Do you recognize this species? ☐ Yes ☐ No ☐ Don't know
    [If answer is Don't Know, skip following questions about this species.]

b. What is its name? _____ ☐ Don't know
Have you seen this species before? ☐ Yes ☐ No ☐ Don't know
c. Where did you last see it physically? _____(place)
☐ In the forest ☐ In the village ☐ In the market ☐ In someone else's house
☐ In a zoo ☐ Other _____
d. When did you last see it? _____ (time)
e. Is this species still found in the wild in this area? ☐ Yes ☐ No ☐ Don't know
f. If no, did it used to be found here? ☐ Yes ☐ No ☐ Don't know
g. Is this species rare or common? ☐ Many ☐ Not many ☐ Rare ☐ None
☐ Don't know
h. Where does this species live? ☐ In water ☐ In the forest ☐ Don't know ☐
Other/details _____
i. Is this species sold? ☐ Yes ☐ No ☐ Don't know

16. [Platysternon megacephalum 大头扁龟, 硬嘴龟, 平胸龟 Big Headed Turtle]
a. Do you recognize this species? ☐ Yes ☐ No ☐ Don't know
[If answer is Don't Know, skip following questions about this species.]
b. What is its name? _____ ☐ Don't know
Have you seen this species before? ☐ Yes ☐ No ☐ Don't know
c. Where did you last see it physically? _____(place)
☐ In the forest ☐ In the village ☐ In the market ☐ In someone else's house
☐ In a zoo ☐ Other _____
d. When did you last see it? _____ (time)
e. Is this species still found in the wild in this area? ☐ Yes ☐ No ☐ Don't know
f. If no, did it used to be found here? ☐ Yes ☐ No ☐ Don't know
g. Is this species rare or common? ☐ Many ☐ Not many ☐ Rare ☐ None
☐ Don't know
h. Where does this species live? ☐ In water ☐ In the forest ☐ Don't know ☐
Other/details _____
i. Is this species sold? ☐ Yes ☐ No ☐ Don't know

17. Are there other turtle species that live around here that are not in these photos?
_____

18. [For all turtles, with picture cards]
Order these species from what you think is the most economically valuable to least valuable species.
1_____ 2_____3_____4_____5_____6_____
7_____8_____9_____10_____11_____

[For all species in Q19-Q24, show photos one by one]

19. [Black bear]
a. Do you know this animal?
☐Yes, name_____ ☐Don't know
b. Is this animal found around here? ☐Yes ☐ No ☐Don't know
c. Was this animal around here in the past? ☐Yes ☐ No ☐Don't know
[If answer is found here before but not now:]
d. When did it disappear from around here? _____ ☐Don't know
e. What do you think caused it to disappear from around here? _____ ☐Don't know

f. Does this animal have any use value? ☐Yes ☐ No ☐Don't know
What is it?
_____

20. [Clouded leopard]
a. Do you know this animal? ☐Yes, name_____ ☐Don't know
b. Is this animal found around here? ☐Yes ☐ No ☐Don't know
c. Was this animal around here in the past? ☐Yes ☐ No ☐Don't know
[If answer is found here before but not now:]
d. When did it disappear from around here? _____ ☐Don't know
e. What do you think caused it to disappear from around here? _____ ☐Don't know
f. Does this animal have any use value? ☐Yes ☐ No ☐Don't know
What is it? _____

21. [Sambar]
a. Do you know this animal? ☐Yes, name_____ ☐Don't know
b. Is this animal found around here? ☐Yes ☐ No ☐Don't know
c. Was this animal around here in the past? ☐Yes ☐ No ☐Don't know
[If answer is found here before but not now:]
d. When did it disappear from around here? _____ ☐Don't know
e. What do you think caused it to disappear from around here? _____ ☐Don't know
f. Does this animal have any use value? ☐Yes ☐ No ☐Don't know
What is it? _____

22. [Hainan gymnure]
Do you know what this animal is? ☐Know ☐Don't know
Know the name _____ size / diet / appearance
_____
[If do not know, ask whether they have heard of this species and its features, and if they know the characteristics of this species, then continue to ask the following question]
_____
Have you seen these animals in the forest? ☐Yes ☐No
If yes, the last time seen _____and the place_____
If seen, the total number of sightings _____ and frequency of sightings_____
If no, then how do you know about this animal?
_____
Do you think this animal is now: ☐ None ☐Rare ☐Not many ☐Many

Do you know what a "gymnure" is? ☐Yes ☐ No

23. [Silver pheasant]
Do you know what this animal is? ☐Know ☐Don't know
Know the name _____ size / diet / appearance
_____
[If do not know, ask whether they have heard of this species and its features, and if they know the characteristics of this species, then continue to ask the following question]
_____
Have you seen these animals in the forest? ☐Yes ☐No
If yes, the last time seen _____and the place_____
If seen, the total number of sightings _____ and frequency of sightings_____
If no, then how do you know about this animal?
_____
Do you think this animal is now: ☐ None ☐Rare ☐Not many ☐Many

24. [Hainan peacock pheasant]
Do you know what this animal is? ☐Know ☐Don't know

Know the name _____ size / diet / appearance

_____

[If do not know, ask whether they have heard of this species and its features, and if they know the characteristics of this species, then continue to ask the following question]

_____

Have you seen these animals in the forest? ☐Yes ☐No
If yes, the last time seen _____and the place_____
If seen, the total number of sightings _____ and frequency of sightings_____
If no, then how do you know about this animal?

_____

Do you think this animal is now: ☐ None ☐Rare ☐Not many ☐Many

SECTION 4 PERCEPTIONS, ATTITUDES, AND BEHAVIOUR

1. a. What do you think is the cause for species' decline in abundance around Bawangling?
   _____ ☐Don't know
   b. What do you think is the cause for species' disappearance?
   _____ ☐Don't know
2. a. Are there any activities that cause wildlife to decline? ☐Yes ☐ No ☐Don't know
   b. What activities? _____
   c. Are these behaviours still going on? ☐Yes ☐ No ☐Don't know
   d. Who does these activities? _____☐Don't know
3. a. Do people from this village caused wildlife to decline? ☐Yes ☐ No ☐Don't know
   b. Do people from other places cause wildlife to decline? ☐Yes ☐ No ☐Don't know
4. Do you think endangered wildlife species should be protected?
   ☐Yes ☐ No ☐Don't know
   Why or why not? _____

5. Who do you think should be responsible for protecting endangered species/'wildlife"?
   ☐Don't know

Who	Why responsible

[For Q6-9, ask all interviewees].

6. Currently, what is your main source of livelihood?

   _____

7. What would you most like do as your main source of livelihood?

   _____

8. If you were to adopt the preferred source of livelihood mentioned above, what kind of extra help or training would you need?

   _____

9. To what extent do you agree with the following statements?
   a) The nature reserve is doing a good job at conserving wildlife species.

☐Agree ☐Neither agree nor disagree ☐Disagree

b) Local people should use natural resources from inside the nature reserve.
☐Agree ☐Neither agree nor disagree ☐Disagree

c) The establishment of the nature reserve near here is a good thing for me.
☐Agree ☐Neither agree nor disagree ☐Disagree

d) Local people should continue to hunt wild animals.
☐Agree ☐Neither agree nor disagree ☐Disagree

e) It is ok to collect firewood from inside the nature reserve for our own use at home.
☐Agree ☐Neither agree nor disagree ☐Disagree

问卷号：_____ 日期：_____ 村名：_____采访者：_____

采访说明

我们是海南大学的学生，在研究环境科学。本次采访对我们了解环境生态非常重要，希望您能尽可能如实地回答问卷里所有的问题。本次采访大约需要 40 分钟。采访是匿名的，您的身份不能核实。受访者需年满 18 岁。您可以随时停止采访。如果您以后有问题，或者想补充更多信息，可以记下我的联系方式：马天骄，手机 13910971742，微信 heidima0825。

您是否愿意接受采访：☐是 ☐否

第一部分 基本信息

1. 您是否已经接受过采访？☐是 ☐否 谁来采访的？_____什么内容？_____
2. 您多大年龄？_____
3. 您的性别？☐ 男 ☐ 女
4. 您是哪个民族？☐ 黎族 ☐ 苗 ☐ 汉 ☐ 其他：_____
5. 您识字吗？☐ 识字 ☐识字，但不多 ☐ 不识字
6. 您能懂哪些语言？☐ 黎话 ☐ 苗话 ☐ 普通话 ☐ 海南话 ☐ 其他 _____
7. 您在这个村子生活了多少年？☐ 一辈子 ☐ 其他：_____ 年
   [如回答其他]您来自哪里？_____ 以前在哪里生活？_____在这里住了多少年？_____年
8. 您有几个小孩和您一起居住？_____ 多大年龄？_____
   除了孩子，还有几口人和您一起居住？_____他们和您都是什么关系？_____
9. 您从事什么职业？☐ 没有工作 ☐ 农民 ☐ 养殖业 ☐ 教师 ☐ 学生 ☐ 林业工人 ☐ 政府工作人员 ☐ 退休 退休了多少年？_____年 ☐ 其他_____
10. 您的总家庭年收入是多少？_____元
11. 您的最高教育程度是多少？☐ 从未接受教育 ☐ 小学 ☐ 初中 ☐ 高中 ☐ 大学 ☐ 大专 ☐ 研究生或更高 ☐ 其他：_____

第二部分 森林资源利用

1. 您现在多久上一次山？_____
   您一个月内是否至少上一次山？☐是 ☐ 否
2. 您上山时会做些什么（包括以前）？
   _____
3. 山上有什么东西对您是有利用价值的？
   _____
   您平均多久会采集这些东西？

资源 1 _____ ☐每天 ☐ 一星期一次 ☐ 一个月一次 ☐ 一年一次
资源 2 _____ ☐每天 ☐ 一星期一次 ☐ 一个月一次 ☐ 一年一次
资源 3 _____ ☐每天 ☐ 一星期一次 ☐ 一个月一次 ☐ 一年一次

4. 您多经常去县城？_____
   您一个月内是否至少去一次县城？ ☐是 ☐ 否
5. 您一般去县城会做些什么？☐去医院/诊所 ☐买东西 买什么_____ ☐接送小孩上学 ☐去银行
   ☐去邮局/邮寄 ☐其他 _____
6. 往返一次的路费花多少钱？_____元
7. 用什么交通工具去县城？_____
8. 如果城里没有您需要的东西或服务，要去哪里才能找到?_____

第三部分 对野生动物的认知

25. a. 在您居住的时间内，*野生动物整体的数量*有变化吗？
   ☐ 增多了 ☐ 减少了 ☐ 没有变化 ☐ 不知道
   [如回答‘增多’或‘减少’，继续问以下问题。否则跳到第 2 题。]
   b. 野生动物数量什么时候变化的？_____年以前 ☐ 不知道
   c. 在哪里有变化？_____
   ☐ 不知道
   d. 怎么知道有变化的？ _____
   ☐ 不知道
   e. 有没有听老人说野生动物的多少有变化？ _____
   ☐ 不知道
26. a. 在您居住的时间内，哪种动物的*数量减少了*？ ☐有 ☐没有 ☐ 不知道
   b. 请把能想到的都列出来：[按受访者列出来的顺序记录]

物种	什么时候减少的

27. a. 在您居住的时间内，哪种动物的*完全消失了*？☐有 ☐没有 ☐ 不知道

b. 请把能想到的都列出来：[按受访者列出来的顺序记录]

物种	什么时候消失的

28. a. 您野生动物有可能从一个地方完全消失，再也没有了吗？☐可能 ☐不可能 ☐不知道

b. "灭绝"对您来说是什么意思？ _____☐不知道

c. 您有没有听老者说过动物"灭绝"☐有 ☐没有

d.您有没有从媒体上(电视，微信，网络)听说过动物"灭绝" ☐有 ☐没有

e. 您有没有听外来人(来过本村的人)讲过"灭绝"？ ☐有 ☐没有 ☐ 哪里来的人？

f. 您还从哪些地方听到过"灭绝"？

_____

29. 在霸王岭周边有哪些乌龟种类？[按受访者列出来的顺序记录]

_____
_____
_____
_____

[问下列问题 6-16 时请逐个出示龟类图片]

30. [Sacalia quadriocellata 四眼斑龟，臭龟 Four-eyed Turtle]

a.认识这种龟吗？☐认识 ☐不认识 ☐不知道

[如回答不认识，跳过针对这个物种的下列问题]

b. 叫什么名字？ _____ ☐不知道

你见过这种龟吗？☐ 是 ☐ 否 ☐ 不知道

c. 最后一次在哪儿见到的？_____

☐森林里 ☐村子里 ☐市场上 ☐别人家 ☐动物园 ☐其他 _____

d. 最后一次是什么时候见到的？_____

e. 这种龟现在在这里还有野生的吗？☐ 是 ☐ 否 ☐ 不知道

f. 如现在没有，以前这里有吗？☐ 是 ☐ 否 ☐ 不知道

g. 这种龟的多少？ ☐很多 ☐多 ☐很少 ☐没有 ☐不知道

h. 这种龟在哪里能找到？☐水里 ☐森林里 ☐不知道 ☐其他

i. 这种龟有买卖吗？ ☐ 有 ☐ 没有 ☐ 不知道

31. [Cuora mouhotii 锯缘龟，八角龟 Keeled Box Turtle]

a.认识这种龟吗？☐认识 ☐不认识 ☐不知道

[如回答不认识，跳过针对这个物种的下列问题]

b. 叫什么名字？_____ ☐不知道

你见过这种龟吗？☐ 是 ☐ 否 ☐ 不知道

c. 最后一次在哪儿见到的？_____

☐森林里 ☐村子里 ☐市场上 ☐别人家 ☐动物园 ☐其他 _____

d. 最后一次是什么时候见到的？_____

e. 这种龟现在在这里还有野生的吗？☐ 是 ☐ 否 ☐ 不知道

f. 如现在没有，以前这里有吗？☐ 是 ☐ 否 ☐ 不知道

g. 这种龟的多少？ ☐很多 ☐多 ☐很少 ☐没有 ☐不知道

h. 这种龟在哪里能找到？☐水里 ☐森林里 ☐不知道 ☐其他

i. 这种龟有买卖吗？ ☐ 有 ☐ 没有 ☐ 不知道

32. [Geoemyda spengleri 锯齿地龟，小八角龟，枫叶龟 Black-breasted Leaf Forest Turtle]

a.认识这种龟吗？☐认识 ☐不认识 ☐不知道

[如回答不认识，跳过针对这个物种的下列问题]

b. 叫什么名字？_____ ☐不知道

你见过这种龟吗？☐ 是 ☐ 否 ☐ 不知道

c. 最后一次在哪儿见到的？_____

☐森林里 ☐村子里 ☐市场上 ☐别人家 ☐动物园 ☐其他 _____

d. 最后一次是什么时候见到的？_____

e. 这种龟现在在这里还有野生的吗？☐ 是 ☐ 否 ☐ 不知道

f. 如现在没有，以前这里有吗？☐ 是 ☐ 否 ☐ 不知道

g. 这种龟的多少？ ☐很多 ☐多 ☐很少 ☐没有 ☐不知道

h. 这种龟在哪里能找到？☐水里 ☐森林里 ☐不知道 ☐其他

i. 这种龟有买卖吗？ ☐ 有 ☐ 没有 ☐ 不知道

33. [Mauremys mutica 材棺龟，石龟，黄喉泥水龟，南石龟，石金钱 Yellow Pond turtle]

a.认识这种龟吗？☐认识 ☐不认识 ☐不知道

[如回答不认识，跳过针对这个物种的下列问题]

b. 叫什么名字？_____ ☐不知道

你见过这种龟吗？☐ 是 ☐ 否 ☐ 不知道

c. 最后一次在哪儿见到的？_____

☐森林里 ☐村子里 ☐市场上 ☐别人家 ☐动物园 ☐其他 _____

d. 最后一次是什么时候见到的？_____

e. 这种龟现在在这里还有野生的吗？☐ 是 ☐ 否 ☐ 不知道

f. 如现在没有，以前这里有吗？☐ 是 ☐ 否 ☐ 不知道

g. 这种龟的多少？ ☐很多 ☐多 ☐很少 ☐没有 ☐不知道

h. 这种龟在哪里能找到？☐水里 ☐森林里 ☐不知道 ☐其他

i. 这种龟有买卖吗？ ☐ 有 ☐ 没有 ☐ 不知道

34. [Pelodiscus sinensis 中华鳖 Chinese Softshell Turtle]

a.认识这种龟吗？☐认识 ☐不认识 ☐不知道

[如回答不认识，跳过针对这个物种的下列问题]

b. 叫什么名字？_____ ☐不知道

你见过这种龟吗？☐ 是 ☐ 否 ☐ 不知道

c. 最后一次在哪儿见到的？_____

☐森林里 ☐村子里 ☐市场上 ☐别人家 ☐动物园 ☐其他 _____

d. 最后一次是什么时候见到的？_____

e. 这种龟现在在这里还有野生的吗？☐ 是 ☐ 否 ☐ 不知道

f. 如现在没有，以前这里有吗？☐ 是 ☐ 否 ☐ 不知道

g. 这种龟的多少？ ☐很多 ☐多 ☐很少 ☐没有 ☐不知道

h. 这种龟在哪里能找到？☐水里 ☐森林里 ☐不知道 ☐其他

i. 这种龟有买卖吗？ ☐ 有 ☐ 没有 ☐ 不知道

35. [Mauremys sinensis 中华花龟，海花，海南花龟 Chinese Golden Thread Turtle]

a.认识这种龟吗？☐认识 ☐不认识 ☐不知道

[如回答不认识，跳过针对这个物种的下列问题]

b. 叫什么名字？_____ ☐不知道

你见过这种龟吗？☐ 是 ☐ 否 ☐ 不知道

c. 最后一次在哪儿见到的？_____

☐森林里 ☐村子里 ☐市场上 ☐别人家 ☐动物园 ☐其他 _____

d. 最后一次是什么时候见到的？_____

e. 这种龟现在在这里还有野生的吗？☐ 是 ☐ 否 ☐ 不知道

f. 如现在没有，以前这里有吗？☐ 是 ☐ 否 ☐ 不知道

g. 这种龟的多少？ ☐很多 ☐多 ☐很少 ☐没有 ☐不知道

h. 这种龟在哪里能找到？☐水里 ☐森林里 ☐不知道 ☐其他

i. 这种龟有买卖吗？ ☐ 有 ☐ 没有 ☐ 不知道

36. [Cuora trifasciata 金钱龟 Golden Coin Turtle]

a.认识这种龟吗？☐认识 ☐不认识 ☐不知道

[如回答不认识，跳过针对这个物种的下列问题]

b. 叫什么名字？_____ ☐不知道

你见过这种龟吗？☐ 是 ☐ 否 ☐ 不知道

c. 最后一次在哪儿见到的？_____

☐森林里 ☐村子里 ☐市场上 ☐别人家 ☐动物园 ☐其他 _____

d. 最后一次是什么时候见到的？_____

e. 这种龟现在在这里还有野生的吗？☐ 是 ☐ 否 ☐ 不知道

f. 如现在没有，以前这里有吗？☐ 是 ☐ 否 ☐ 不知道

g. 这种龟的多少？ ☐很多 ☐多 ☐很少 ☐没有 ☐不知道

h. 这种龟在哪里能找到？☐水里 ☐森林里 ☐不知道 ☐其他

i. 这种龟有买卖吗？ ☐ 有 ☐ 没有 ☐ 不知道

37. [Clemmys guttata 黄斑水龟 Spotted Turtle]

a.认识这种龟吗？☐认识 ☐不认识 ☐不知道

[如回答不认识，跳过针对这个物种的下列问题]

b. 叫什么名字？_____ ☐不知道

你见过这种龟吗？☐ 是 ☐ 否 ☐ 不知道

c. 最后一次在哪儿见到的？_____

☐森林里 ☐村子里 ☐市场上 ☐别人家 ☐动物园 ☐其他 _____

d. 最后一次是什么时候见到的？_____

e. 这种龟现在在这里还有野生的吗？☐ 是 ☐ 否 ☐ 不知道

f. 如现在没有，以前这里有吗？☐ 是 ☐ 否 ☐ 不知道

g. 这种龟的多少？ ☐很多 ☐多 ☐很少 ☐没有 ☐不知道

h. 这种龟在哪里能找到？☐水里 ☐森林里 ☐不知道 ☐其他

i. 这种龟有买卖吗？ ☐ 有 ☐ 没有 ☐ 不知道

38. [Cuora galbinifrons 黄额闭壳龟，黄额盒龟，草龟，山草龟，红旗龟，假金钱龟 Indochinese Box Turtle]

a.认识这种龟吗？☐认识 ☐不认识 ☐不知道

[如回答不认识，跳过针对这个物种的下列问题]

b. 叫什么名字？_____ ☐不知道

你见过这种龟吗？☐ 是 ☐ 否 ☐ 不知道

c. 最后一次在哪儿见到的？_____

☐森林里 ☐村子里 ☐市场上 ☐别人家 ☐动物园 ☐其他 _____

d. 最后一次是什么时候见到的？_____

e. 这种龟现在在这里还有野生的吗？☐ 是 ☐ 否 ☐ 不知道

f. 如现在没有，以前这里有吗？☐ 是 ☐ 否 ☐ 不知道

g. 这种龟的多少？ ☐很多 ☐多 ☐很少 ☐没有 ☐不知道

h. 这种龟在哪里能找到？☐水里 ☐森林里 ☐不知道 ☐其他

i. 这种龟有买卖吗？ ☐ 有 ☐ 没有 ☐ 不知道

39. [Palea steindachneri 疣颈龟，山瑞鳖 Wattle-necked Softshell Turtle]

a.认识这种龟吗？☐认识 ☐不认识 ☐不知道

[如回答不认识，跳过针对这个物种的下列问题]

b. 叫什么名字？_____ ☐不知道

你见过这种龟吗？☐ 是 ☐ 否 ☐ 不知道

c. 最后一次在哪儿见到的？_____

☐森林里 ☐村子里 ☐市场上 ☐别人家 ☐动物园 ☐其他 _____

d. 最后一次是什么时候见到的？_____

e. 这种龟现在在这里还有野生的吗？☐ 是 ☐ 否 ☐ 不知道

f. 如现在没有，以前这里有吗？☐ 是 ☐ 否 ☐ 不知道

g. 这种龟的多少？ ☐很多 ☐多 ☐很少 ☐没有 ☐不知道

h. 这种龟在哪里能找到？☐水里 ☐森林里 ☐不知道 ☐其他

i. 这种龟有买卖吗？ ☐ 有 ☐ 没有 ☐ 不知道

40. [Platysternon megacephalum 大头扁龟，硬嘴龟，平胸龟 Big Headed Turtle]

a.认识这种龟吗？☐认识 ☐不认识 ☐不知道

[如回答不认识，跳过针对这个物种的下列问题]

b. 叫什么名字？_____ ☐不知道

你见过这种龟吗？☐ 是 ☐ 否 ☐ 不知道

c. 最后一次在哪儿见到的？_____

☐森林里 ☐村子里 ☐市场上 ☐别人家 ☐动物园 ☐其他 _____

d. 最后一次是什么时候见到的？_____

e. 这种龟现在在这里还有野生的吗？☐ 是 ☐ 否 ☐ 不知道

f. 如现在没有，以前这里有吗？☐ 是 ☐ 否 ☐ 不知道

g. 这种龟的多少？ ☐很多 ☐多 ☐很少 ☐没有 ☐不知道

h. 这种龟在哪里能找到？☐水里 ☐森林里 ☐不知道 ☐其他

i. 这种龟有买卖吗？ ☐ 有 ☐ 没有 ☐ 不知道

41. 您还知道霸王岭附近有哪些龟类是以上图片中没有的？

_____

42. [用所有的图片请受访者排序，记录图片背后的代码]

请将这些龟类按照经济价值排序，从最有价值的到最没价值的。

1_____2_____3_____4_____5_____6_____7_____8_____9_____
10_____11_____

43. [黑熊照片]

a. 您认识这种动物吗? ☐ 认识，名字_____ ☐ 不认识 ☐ 不知道名字

b. 这种动物在这里有吗？ ☐ 有 ☐ 没有 ☐ 不知道

c. 这种动物以前在这里有吗？ ☐ 有 ☐ 没有 ☐ 不知道

[如果回答这里现在没有，但以前有：]

e. 什么时候从这里没有了？ _____年前 ☐ 不知道

f. 您认为为什么从这里没有了？ _____
☐ 不知道

g. 这种动物有利用价值吗？☐有 ☐没有 ☐ 不知道

什么价值？ _____

44. [云豹照片]

a. 您认识这种动物吗? ☐ 认识，名字_____ ☐ 不认识 ☐ 不知道名字

b. 这种动物在这里有吗？ ☐ 有 ☐ 没有 ☐ 不知道

c. 这种动物以前在这里有吗？ ☐ 有 ☐ 没有 ☐ 不知道

[如果回答这里现在没有，但以前有：]

e. 什么时候从这里没有了？ _____年前 ☐ 不知道

f. 您认为为什么从这里没有了？ _____
☐ 不知道

g. 这种动物有利用价值吗？☐有 ☐没有 ☐ 不知道

什么价值？ _____

45. [水鹿照片]

a. 您认识这种动物吗? ☐ 认识，名字_____ ☐ 不认识 ☐ 不知道名字

b. 这种动物在这里有吗？ ☐ 有 ☐ 没有 ☐ 不知道

c. 这种动物以前在这里有吗？ ☐ 有 ☐ 没有 ☐ 不知道

[如果回答这里现在没有，但以前有：]

e. 什么时候从这里没有了？ _____年前 ☐ 不知道

f. 您认为为什么从这里没有了？ _____
☐ 不知道

g. 这种动物有利用价值吗？☐有 ☐没有 ☐ 不知道

什么价值？ _____

46. [毛猥照片]

你知道这是什么动物吗？ ☐知道 ☐不知道

知道，名称_____大小/食性/外貌_____

不知道，问是否有听说过这物种以及它的特征，如果知道物种特征，继续问以下问题

_____

_____

你在山上见过这动物吗? ☐有 ☐没有

有，上次看见的时间_____地点_____

看见总次数_____如果常见，频率是

_____

你觉得这个动物现在是 ☐没有 ☐很少 ☐不多 ☐很多

您知道“毛猥”是什么吗？☐知道 ☐不知道　如何知道的?

_____

47. [白鹇照片]

你知道这是什么动物吗？ ☐知道 ☐不知道

知道，名称_____大小/食性/外貌

_____

不知道，问是否有听说过这物种以及它的特征，如果知道物种特征，继续问以下问题

_____

你在山上见过这动物吗? ☐有 ☐没有

有，上次看见的时间_____地点

_____

看见总次数_____如果常见，频率是_____

没有，你是如何知道这动物的？

_____

你觉得这个动物现在是 ☐没有 ☐很少 ☐不多 ☐很多

48. [孔雀雉照片]

你知道这是什么动物吗？ ☐知道 ☐不知道

知道，名称_____大小/食性/外貌_____

不知道，问是否有听说过这物种以及它的特征，如果知道物种特征，继续问以下问题

_____

你在山上见过这动物吗? ☐有 ☐没有

有，上次看见的时间_____地点

_____

看见总次数_____如果常见，频率是

_____

没有，你是如何知道这动物的？

_____

你觉得这个动物现在是 ☐没有 ☐很少 ☐不多 ☐很多

第四部分 认知、态度、人类行为

1. a. 您认为霸王岭附近野生动物减少的原因是什么？ ☐ 不知道

   _____

   b. 您认为野生动物完全消失的原因是什么？ ☐ 不知道

   _____

2. a. 有哪些人为活动会造成野生动物减少？ ☐ 不知道

   _____

   b. 什么行为？ ☐ 不知道

   _____

   c. 这些认为行为还存在吗？☐有 ☐没有 ☐ 不知道

   d. 什么人做这些行为？

   _____

3. a. 您认为是本村人造成野生动物减少吗？ ☐是 ☐ 否 ☐ 不知道

   b. 您认为是外来人造成野生动物减少吗？ ☐是 ☐ 否 ☐ 不知道

4. 您认为野生动物是否因该被保护？ ☐ 是 ☐ 否 ☐ 不知道

   为什么？ _____ ☐ 不知道

5. 您认为谁应该承担保护野生动物的责任？为什么？

   [按受访者列出来的顺序记录]

谁	为什么有责任

[所有人都问以下问题]

6. 您目前的收入来源是什么？

   _____

7. 您最希望靠什么做工作获得收入来源？

   _____

8. 如果您想采取上述的收入来源，需要哪些培训或帮助？

   _____

9. 您对以下的话什么态度？

a) 目前自然保护区对野生动物保护的力度足够了。☐同意 ☐ 不知道 ☐ 不同意

b) 人们应当利用自然保护区里的自然资源。 ☐同意 ☐ 不知道 ☐ 不同意

c) 自然保护区的设立对我来说是好事。 ☐同意 ☐ 不知道 ☐ 不同意

d) 当地人应该继续打猎或捕捉野生动物。 ☐同意 ☐ 不知道 ☐ 不同意

e) 从林子里采集木材柴火在家里用没有什么问题。☐同意 ☐ 不知道 ☐ 不同意