

# Tourists attitude change in wildlife consumption in and around protected areas in China

Wenjuan Yang<sup>a</sup>, Qiu He<sup>a</sup>, Lu Wang<sup>a</sup>, Yafei Wang<sup>a</sup>, Wang Liao<sup>a</sup>, Wei Ji<sup>b</sup>, Yawen Zhang<sup>c</sup>, Jie Chen<sup>a,\*,1</sup>

<sup>a</sup> Research Institute of Forestry Policy and Information, Chinese Academy of Forestry, Beijing 100091, China

<sup>b</sup> Committee of Endangered Wildlife Conservation, Shanghai Wildlife Conservation Association, Shanghai 200065, China

<sup>c</sup> School of Economics & Management, Beijing Forestry University, Beijing 100091, China

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## ABSTRACT

After the outbreak of COVID-19, China has taken a quick action and issued a ban on terrestrial wildlife consumption. After 2 years' implementation of the ban, the long effect of ban is a concern. In order to understand the public attitudes towards wildlife consumption and its change before and after the outbreak of the pandemic, the study was conducted among tourists in Zhalong and Xishuangbanna nature reserves, where there has been news on tourists consuming wildlife before the pandemic. A total of 348 valid questionnaires (128 in Zhalong and 220 in Xishuangbanna) were collected. The survey results show that collaborative actions coordinating strict enforcement and publicity is the most critical factor affecting wildlife protection. The top two reasons why tourists ceased consuming wildlife were wildlife consumption ban and fear of the zoonotic disease, while extensive publicity was the determinant factor to the high perception of the strict enforcement and the risk of zoonotic diseases caused by wildlife among tourists. And tourists have a higher sense of responsibility for wildlife protection after the outbreak of the pandemic, more than 50 % tourists (61.9 % in Zhalong and 48.4 % in Xishuangbanna) would like to take more proactive action than only refusing to buy wildlife, such as reporting to authorities and dissuading others from buying when encountering illegal wildlife selling. However, it is found that more efforts should be taken to enhance the tourists' knowledge of wildlife and wildlife protection laws. Even though about 90 % tourists know about the ban and other legislations on wildlife, about half of tourists have no clear idea about the specific provisions. The knowledge about wildlife is even poorer, only about one third of tourists surveyed gave 100 % correct answer to the questions about the species that are categorized as wildlife and the wildlife that are permitted to be farmed and eat. Geography is found to have influences on tourists' law compliance and perception of wildlife protection. The tourists from the north show stronger obedience to government requirements but have less knowledge of wildlife legislations, while those from the south, who have the better knowledge of wildlife legislations, show a lower inclination (65.5 % in Xishuangbanna) for the permanent ban on wildlife consumption. The tourists surveyed with higher education or employed in wildlife-related sectors have cautious attitudes towards the complete and permanent ban and prefer to support the science-based management of wildlife protection.

## 1. Introduction

After its outbreak in Wuhan, China in late 2019, COVID-19, a zoonotic disease was declared by the World Health Organization as a pandemic [1]. While there is no concrete evidence that this coronavirus of SARS-CoV-2 was harboured in and transmitted from wildlife, many

studies suggest that bats, snakes or pangolins can be feasible carriers of the closest viral strains [2]. This means that COVID-19 may be transmitted from bats, snakes or pangolins through an intermediary wildlife to humans [3]. In fact, in addition to COVID-19, emerging infectious diseases around the world in recent years, such as Ebola, H5N1, SARS and MERS, are all zoonotic diseases [4]. Studies have shown that the

\* Corresponding author.

E-mail address: [jie\\_chen2007@163.com](mailto:jie_chen2007@163.com) (J. Chen).

<sup>1</sup> Post address: Research Institute of Forestry Policy and Information, Chinese Academy of Forestry, No. 1 Dongxiaofu, Xiangshan Road, Haidian District, Beijing 100,091, China.

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incidence of many zoonotic diseases is closely related to wildlife trade [5]. As a result, the issue of “eating wildlife threatening public health” has aroused great concerns around the world and triggered wide discussions on wildlife consumption, wildlife protection and the modification of wildlife related laws and policies after the outbreak of the pandemic.

As the first country in the world that recovers from the pandemic, China has seen a heated public discussion on legislation modification for wildlife protection [6,7] and the public-interest litigation against wildlife crimes [8], which led to the ban on trading in wild-caught animals for food and closing of wildlife farms and markets [7,9]. In this condition, the Standing Committee of the National People's Congress adopted on February 24, 2020 the decision on cracking down on the illegal trading of wildlife and eradicating the consumption of wildlife to protect people's lives and health, which states that it is illegal to consume “terrestrial wildlife of important ecological, scientific and social values” and other terrestrial wildlife, including those that are bred or reared in captivity [10]. The decision actually prevents all the terrestrial wildlife from being eaten as China Wildlife Protection Law has banned the eating of wildlife under national protection, which are only 406 species. Besides, the decision was quickly and strictly enforced and a large number of wildlife breeding sites as well as wildlife markets were closed almost overnight [11]. In this context, the most possible place to buy and consume wildlife is where the wildlife is distributed. As most protected areas are in remote region and used to be poverty-stricken area, local communities have long history of dependence on wildlife for a living, especially those that were not listed as protected wildlife before the decision issued in 2020. Nearly all protected area are also the tourism attractions except for the core protection area, and a large number of tourists rushed in, making certain demands for wildlife consumption. There were some reports on the wildlife killing and eating in and at the proximity of protected area [12–14]. Therefore, if we want to know whether people have changed attitudes and behaviors of wildlife consumption after the outbreak of the pandemic and the ban, people around protected areas are a key subject to study. And the people in and around the protected areas can be generally divided into three categories, which are the local villagers, the staff and the tourists. It was reported that local villagers around protected areas have higher wildlife protection awareness [15,16], and the staff of protected areas also have a very high awareness of wildlife protection due to their responsibilities. So we assume that tourists will be the most uncontrollable elements in the supply-demand chain, and once the supply has been cut off, the demand may be subdued or remain strong to trigger a hidden wildlife market [17]. However, there are few reports on how the changed attitude and behaviors of tourists contributes to the wildlife protection, and whether the ban on wildlife trade and consumption really motivate the decreasing wildlife consumption or have the effect of stimulating the informal/underground wildlife trade.

Therefore, questionnaires were developed for tourists who visit protected area to explore the external pressure from Zoonosis, the ban on wildlife eating and corresponding punishments, which have been caused by COVID-19 on their attitude towards wildlife consumption, and how the change of attitude will be transitioned towards internalized awareness and actions to protect wildlife. It is expected that the research could provide inputs and references for policy modification and improvements in China.

## 2. Methods

### 2.1. Study areas

Most wildlife trade and consumption happen in the bordering areas, so our study first identified Xishuangbanna National Nature Reserve, which close to the border, as the study area. Zhalong is located in Heilongjiang Province, which sit at the utmost northern part of China. The people there also have the habits of wildlife consumption because there

were large dense forest and rich resources of wildlife before. In both reserves, there were reports of tourists consuming wildlife around the reserves before COVID-19.

Actually, due to the vast territory of China, people from the south and the north (The southern and northern parts of China are separated by the Qinling Mountains and Huaihe River line, which is the 0 °C isotherm of China in January and the 800 ml isoprecipitation line) show the large difference in lifestyles and diet structure. We also assumed that tourists may generally take short trips during the pandemic, when control measures would be adopted at any time as soon as there was found a case of COVID-19, and most tourists come from the local provinces and the region around the provinces.

Zhalong National Nature Reserve in Heilongjiang (Northeast China) is an ideal area for large waterfowl such as cranes. The world-famous Zhalong Wetland, which is the first in Asia, the fourth in the world and the largest reed wetland in the world, is located there. In 1992, it was listed by Ramsar as “Wetlands of International Importance”. Zhalong Wetland is the largest breeding ground for red-crowned cranes in the world. 6 out of the 15 crane species in the world could be found in Zhalong, and more than 400 red-crowned cranes live in Zhalong Wetland, more than 20 % of the total number of red-crowned cranes in the world (less than 2000) (Fig. 1).

Xishuangbanna National Nature Reserve is located in Xishuangbanna Dai Autonomous Prefecture in southern Yunnan (Southwest China). It consists of five geographically unconnected sub-reserves, Mengyang, Menglun, Mengla, Shangyong and Manqian. It is a large-scale comprehensive nature reserve with the main purpose of protecting tropical forest ecosystems and rare wildlife and plants. It is the largest original tropical forest area in China with relatively complete preservation of tropical forest ecosystem, with extremely rich biological resources (Fig. 1).

### 2.2. Survey design

After a comprehensive review of literature on wildlife protection/consumption, the questionnaire was developed composed of three parts. The first part consists of the questions on the demographics of respondents, such as gender, age, place of residence, education background, occupation, and religion. In the second part, there are three questions on the knowledge regarding wildlife species. The third part, which constitutes the core of the questionnaire, includes 14 questions related to tourists' attitudes towards wildlife consumption. The questionnaire includes a number of response formats, including dichotomous, multiple choice, open-ended options, and Likert rating scales.

During the questionnaire survey, about 10 % of tourists (30 persons) surveyed were randomly selected to have the semi-structure interview under their consent. The participants interviewed spanned all the age

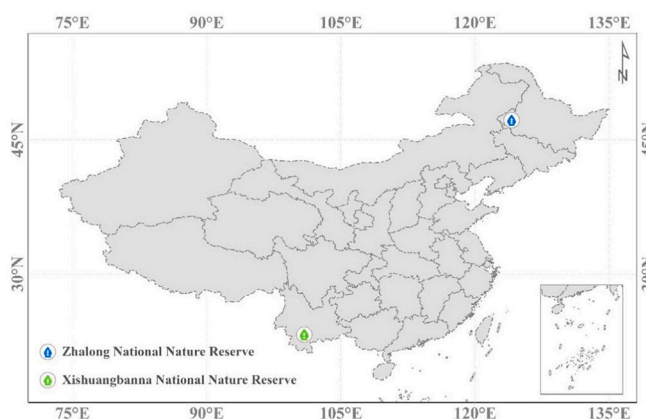


Fig. 1. Locations of Zhalong National Nature Reserve and Xishuangbanna National Nature Reserve.

range, from the elderly to college students. The interview was mainly concentrated on the reasons behind their changed attitudes towards the wildlife eating after the outbreak of the pandemic, and the attitudes towards the complete and permanent ban on wildlife consumption in the context of human-wildlife conflicts, and the factors propelling them to have more proactive actions for wildlife protection. In addition to tourists, we also interviewed local villagers and staff working with the two protected areas during the survey to see if any inquiry of how and where to buy wildlife from tourists are observed. The interview results are used in the discussion.

### 2.3. Informed consent

Participation in the survey and interview was strictly voluntary. Before the participants filled out the questionnaire, the research team would give them detailed background information about the purpose of the survey, and explain that the confidentiality/anonymity of the participants would be protected. Before the questions on the paper, we also put a paragraph explaining the purpose and confidentiality information. With the consent of the participants, the questionnaire survey was officially started. The participants in this survey were all over 18 years old.

### 2.4. Data collection

A preliminary pilot test was conducted in Beijing prior to the questionnaire survey. The results of the pilot study were discussed with experts in the field of wildlife protection, who reviewed and modified the questionnaire.

We know that doing the survey among tourists in nature reserve is difficult and may only have small portion of tourists agree to do the survey. So in the survey we chose to invite tourists to take the survey for ensuring the more gender, age and region balanced among the respondents. In this way, we could ensure certain representatives.

A total of 386 questionnaires were collected in this study, including 137 in Zhalong National Nature Reserve and 249 in Xishuangbanna National Nature Reserve. Questionnaires with incomplete information and “common sense trap questions” were identified as invalid and excluded from the analysis. After screening, a total of 348 effective questionnaires were obtained, with an effective rate of 90.2 %.

### 2.5. Data analysis

The data were processed and analyzed using R-Studio, SPSS 21.0 and Excel 2016. Descriptive statistics were used to summarize the data. We used Excel to calculate demographic characteristics such as gender, age, place of residence, education level, occupation, annual household income, and religious beliefs. All results of variables were presented by the format of frequency (%). The one-way analysis of variance and independent sample *t*-test were applied to analyze the differences between different demographic variables and wildlife awareness. Logit model was used to analyze the factors influencing the attitude towards wildlife legislation. A 95 % confidence interval was adopted in all analyses.

### 2.6. Some stipulating

About the dates. “before the pandemic”, “before the outbreak” and “before COVID-19” in the manuscript refer to before Dec. 2019 when the pandemic broke out in Wuhan. With the approval of the State Council, the control measures for the pandemic were lifted On January 8, 2023 [18]. So “during the pandemic” refers to the time period between Dec. 2019 and January 2023. Meanwhile, “after the outbreak”, “after the outbreak of the pandemic” and “after the outbreak of COVID-19” express the same time period.

About the wildlife consumption. In a broad sense, “wildlife consumption” may include food, medicine, pets and decorations, etc.

However, our study focuses on food, so the “wildlife consumption” in this manuscript is basically equivalent to wildlife eating.

## 3. Results

### 3.1. Participant characteristics

Among the participants, 46.3 % were male and 53.7 % were female, with a male to female ratio of 0.86:1. In Xishuangbanna, the percentages of male and female were 48.2 % and 51.8 %, respectively, while male

**Table 1**  
Sociodemographic characteristics of participants.

	All (n = 348)	Zhalong (n = 128)	Xishuangbanna (n = 220)	P value
<b>Gender, n(%)</b>				0.348
Male	161 (46.3)	55(43.0)	106(48.2)	
Female	187 (53.7)	73(57.0)	114(51.8)	
<b>Age (years) , n(%)</b>				<0.05
Under 30	115 (33.1)	33(25.8)	82(37.3)	
30–40	87 (25.0)	26(20.3)	61(27.7)	
40–50	60 (17.2)	27(21.1)	33(15.0)	
50–60	51 (14.7)	20(15.6)	31(14.1)	
Over 60	35 (10.1)	22(17.2)	13(5.9)	
<b>Education background, n (%)</b>				<0.05
Senior school and lower	151 (43.4)	73(57.0)	78(35.5)	
Bachelor degree or above	197 (56.6)	55(43.0)	142(64.5)	
<b>Household registration</b>				0.098
Rural population	106 (30.5)	46(35.9)	60(27.3)	
Urban population	242 (69.5)	82(64.1)	160(72.7)	
<b>Ethnic, n(%)</b>				0.057
Han	310 (89.1)	119 (93.0)	191(86.8)	
Minority	38 (10.9)	9(7.0)	29(13.2)	
<b>Religious believe, n(%)</b>				<0.05
Yes	44 (12.6)	9(7.0)	35(15.9)	
No	304 (87.4)	119 (93.0)	185(84.1)	
<b>Type of unit, n(%)</b>				<0.05
Corporation	92 (26.4)	24(18.8)	68(30.9)	
Self-employed	74 (21.3)	37(28.9)	37(16.8)	
Government office	50 (14.4)	7(5.5)	43(19.5)	
Research organization and university	23(6.6)	12(9.4)	11(5.0)	
NGO	10(2.9)		10(4.5)	
Freelance (including unemployed)	99 (28.5)	48(37.5)	51(23.2)	
<b>Annual household income, n(%)</b>				<0.05
Within 100,000	131 (37.6)	72(56.3)	59(26.8)	
100,000-200,000	125 (35.9)	43(33.6)	82(37.3)	
200,000-500,000	65 (18.7)	11(8.6)	54(24.5)	
500,000–1 million	20(5.8)	1(0.8)	19(8.6)	
More than 1 million	7(2.0)	1(0.8)	6(2.7)	

and female tourists accounted for 43.0 % and 57.0 % in Zhalong (Table 1).

In terms of age distribution, both Xishuangbanna and Zhalong have the largest proportion of young tourists under the age of 30, i.e., 37.3 % in Xishuangbanna and 25.8 % in Zhalong. There are more elderly tourists over the age of 60 in Zhalong, accounting for 17.2 %, while the elderly tourists in Xishuangbanna accounts for 5.9 %, much less than those in Zhalong. The distribution of other age groups is more uniform.

In terms of education background of tourists, a significant difference between Xishuangbanna and Zhalong is observed. 64.5 % of tourists in Xishuangbanna have bachelor degree or above, while only 43.0 % of tourists in Zhalong. This may be related to the fact that tourists in Zhalong mainly consist of local people, with a larger proportion of elderly people at that, while tourists in Xishuangbanna are dominated by young people who are geographically diverse.

From the ethnic perspective, the ethnic minority tourists accounts for 10.9 %, which is close to the proportion of the ethnic population in the total population of China (8.89 %), of which the ethnic minority tourists in Xishuangbanna accounts for 13.2 % and 7.0 % in Zhalong. In terms of religion, the proportion of tourists with religious belief in Xishuangbanna is 15.9 %, while 7.0 % in Zhalong.

From the regional point of view, tourists in Xishuangbanna come from 28 provinces in China, of which tourists from southwestern provinces of Yunnan, Sichuan and Guizhou account for a largest proportion at 26.3 %, followed by those from Guangdong, Jiangsu and Zhejiang provinces (17.7 %) and from the four municipalities of Beijing, Tianjin, Shanghai and Chongqing (16.0 %), while the remaining 40 % of tourists are from the other 18 provinces. In Zhalong, tourists are mainly from 14 provinces in China, 57.8 % of which are from Heilongjiang Province where Zhalong is located.

In terms of organization, a largest proportion of tourists (30.9 %) in Xishuangbanna work in private company, followed by freelance and the unemployed (23.2 %). In Zhalong, freelance and the unemployed is the largest group, accounting for 37.5 %, followed by the self-employed (28.9 %). In terms of occupation that they are engaged in, other industries account for the largest proportion, 31.4 % in Xishuangbanna and 30.5 % in Zhalong, indicating that there are loopholes in the design of the questionnaire on occupation distribution. The number of tourists in primary industries such as agriculture, forestry and fisheries is 18.8 % in Zhalong, which may result from the large proportion of forest and farmland in Northeast China. In Xishuangbanna, the percentages of tourists working in primary industry, public administration and IT sector are similar, each accounting for about 10 % (Fig. 2).

### 3.2. Changes in attitudes and behaviors caused by Covid-19 and the ban

About 8.6 % of tourists in Zhalong and 9.5 % in Xishuangbanna responded they had eaten wildlife before the pandemic. During the pandemic, these tourists choose to stop or reduce the eating, but there is

a difference between tourists in Zhalong and Xishuangbanna. In Zhalong, all the tourist who had eaten wildlife said that they haven't eaten wildlife any more, but 42.9 % of Xishuangbanna tourists who had eaten wildlife (about 4.1 % of all tourists in Xishuangbanna) still eat after the outbreak (see Fig. 3).

As for the reasons for wildlife consumption, there are obvious difference between Zhalong and Xishuangbanna. In Zhalong, 45.5 % of tourists reflect that recommendation of local people is the most important driver for them to eat, followed by good taste (27.3 %) and experiencing novel things (27.3 %). In Xishuangbanna, 47.6 % answer that they want to experience novel things as tourists for wildlife eating, followed by local people's recommendation (33.3 %) and good taste (19.0 %) (see Fig. 3).

As for the reasons for not eating wildlife, 60.9 % of tourists in Zhalong chose not to eat because they know there are "legislative requirements on wildlife protection", 25.2 % expressed that they have "worries about zoonotic disease", and 9.9 % chose "dislike the taste of wildlife". In Xishuangbanna, 45.8 % refuse to eat because of "legislative requirements on wildlife protection", 23.1 % choose "worries about zoonotic disease", and 25.8 % choose "dislike the taste of wildlife" (see Fig. 4).

Before the pandemic, 0.8 % of tourists in Zhalong and 0 % in Xishuangbanna chose "will definitely buy", and 5.5 % of tourists in Zhalong while 2.7 % in Xishuangbanna chose "possibly buy" when encountering illegal wildlife selling (See Table 2). Of these tourists, 85.7 % are concerned about zoonotic diseases transmitted by wildlife during the pandemic, and are aware that eating wildlife will increase the risk of virus transmission, and they will not buy wildlife when they encounter illegal wildlife selling in the future.

In the future, which means after the outbreak of the pandemic, when encountering illegal wildlife selling, no one in the two protected areas chose to buy, but there are significant differences in their actions. The number of tourists in Xishuangbanna, who would like to refuse to buy and also report it to authorities, is basically the same with those who refuse to buy and also dissuade others not to buy (22.1 %), refuse to buy but will not dissuade other (22.1 %), and ignore the sell (22.9 %). However, more tourists would like to refuse to buy and report to authorities in Zhalong, accounting for 42.1 % (See Table 2).

### 3.3. Knowing of wildlife legislation and concern for disease transmission

Regarding the knowing of *Wildlife Protection Law* and its provisions on wildlife eating and trading, 45.3 % of tourists in Zhalong and 47.7 % in Xishuangbanna "have a good knowing of the legislative requirements", 40.6 % in Zhalong and 45.0 % in Xishuangbanna "have some knowing about the specific provisions". Only a small number of tourists "have few knowing about the legislative requirements", i.e., 14.1 % in Zhalong and 7.3 % in Xishuangbanna (Fig. 5).

Tourist in both the nature reserves have different knowing of wildlife (Fig. 6, Table 3). In Zhalong, 40.6 % of tourists have a correct knowing of all the wildlife listed in the questionnaire, while only 29.5 % in Xishuangbanna can correctly identify that the animals listed all belong to wildlife. 35.9 % of tourists in Xishuangbanna can correctly identify less than 60 % of the wildlife listed, while only 14.8 % in Zhalong. Most of the tourists (more than 70 %) have little problem to identify that spot pythons, pangolin, wild yaks, wild camels, and Tibetan antelope are wildlife, but fail to know that the commonly seen animals like frog are also wildlife. Tourists in Zhalong generally (86.7 %) know that roe deer is a wildlife, while less tourists in Xishuangbanna hold the same conclusion (67.7 %). The tourists in the two nature reserves have also different cognition of geckos. 65.6 % of the tourists in Zhalong think that gecko is a wildlife species while only 47.7 % in Xishuangbanna think so. Less tourist realize that frogs are wildlife, and only 38.6 % of tourists in Xishuangbanna and 53.1 % in Zhalong have the correct understanding.

In terms of wildlife that are listed by the Ministry of Agriculture of

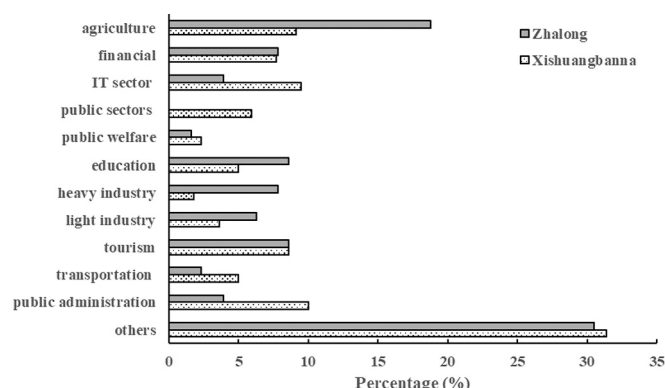


Fig. 2. The sectors where respondents are employed.



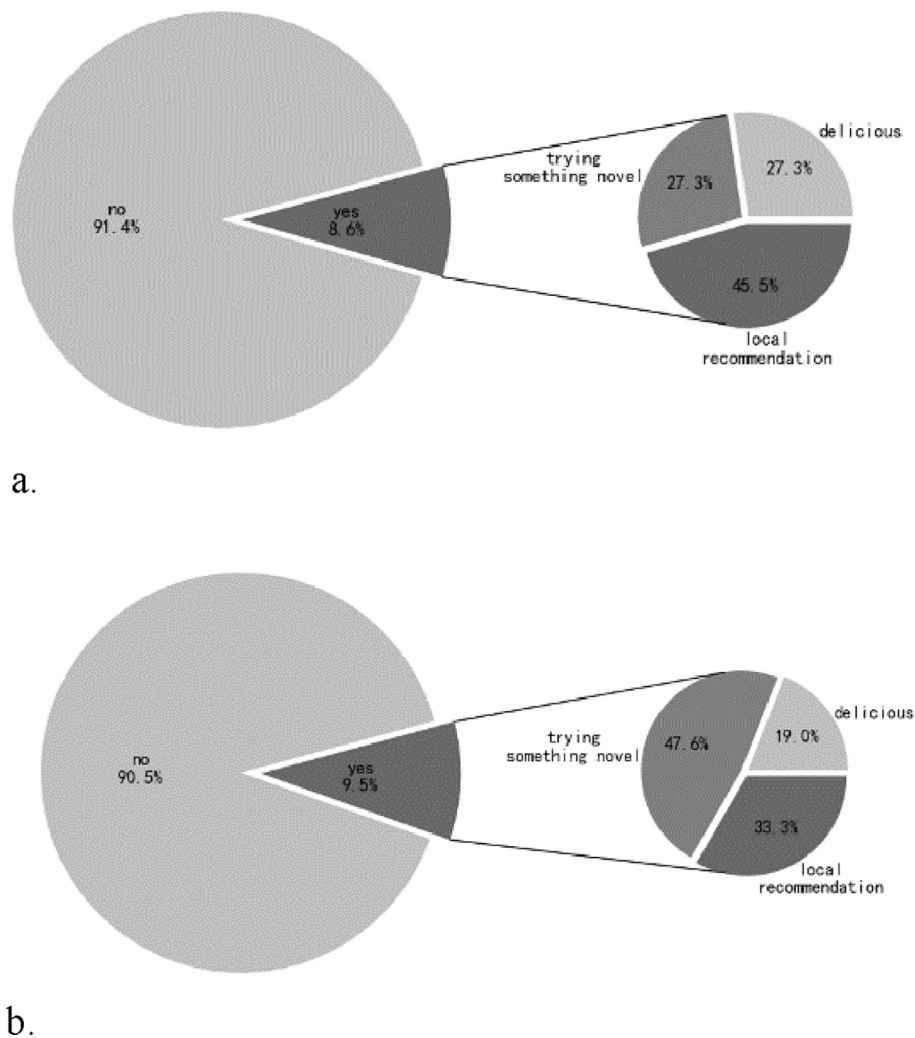


Fig. 3. The proportion of tourists willing to consume wildlife or not in Zhalong (a) and Xishuangbanna (b) and their reasons.

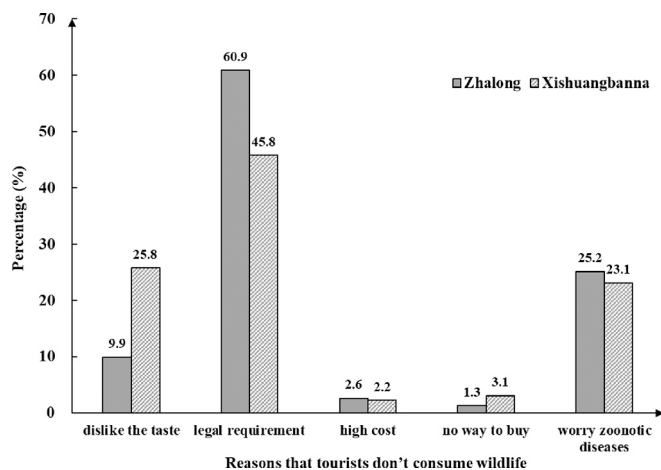


Fig. 4. The reasons that tourists don't consume wildlife in Zhalong and Xishuangbanna.

China as allowed to be captively bred and eaten, the tourists in both Zhalong and Xishuangbanna have much different understandings. For example, they have much similar capacity to identify the captive breeding and eating of sika deer is permitted, 36.8 % in Xishuangbanna and 39.8 % in Zhalong, respectively. But they have a significantly

different recognition of ostrich which is also allowed to be bred and eaten, and nearly half (49.1 %) of the tourists in Xishuangbanna answered correctly, while only 32 % in Zhalong gave the correct answer. The tourists visiting the two nature reserves have rather low recognition of whooper swan and green peacock as the captively bred and eatable wildlife. Regarding whooper swans, 28.1 % of the tourists in Zhalong and 25.5 % in Xishuangbanna believe that whooper swans are allowed to be raised in captivity and eaten. In Zhalong, 8.6 % of people think that green peacocks are allowed to be raised, while 18.6 % hold the same view in Xishuangbanna, showing a significant difference from Zhalong (Table 4).

Due to the pandemic, the tourists in the two nature reserves have an somehow obvious difference between their concerns about zoonotic diseases brought by wildlife and their recognition of the outcomes of eating wildlife. 92.8 % in Zhalong and 85.7 % in Xishuangbanna are concerned about connections between the wildlife eating and zoonotic disease, but about 95.0 % of the tourists in both places (94.4 % in Zhalong and 95.3 % in Xishuangbanna) recognize that eating wildlife may increase the risk of virus transmission (See Table 5).

### 3.4. Attitude towards legislative proposals

There is no big difference in the attitude towards the complete ban on the trading and eating of wildlife. For their views on a complete ban on the trading in wildlife and their products, 96.1 % of tourists in Zhalong express their support to the proposals, 2.3 % disapprove and 1.6 % do

**Table 2**

Actions of tourists when they encounter illegal wildlife selling in Zhalong and Xishuangbanna before and after the COVID-19.

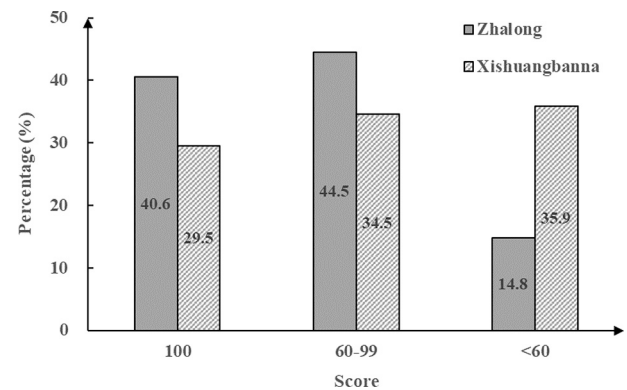
	All(n = 348)	Zhalong (n = 128)	Xishuangbanna (n = 220)	Significance
<b>Actions before the Pandemic</b>				<0.05
Definitely will buy	1(0.3)	1(0.8)		
Possibly will buy	13(3.8)	7(5.5)	6(2.7)	
Refuse to buy	235 (68.9)	94(75.2)	141(65.3)	
Ignore	92 (27.0)	23(18.4)	69(31.9)	
<b>Actions after the pandemic</b>				<0.05
Refuse and report to authorities	110 (32.1)	53(42.1)	57(26.3)	
Refuse and dissuade the other	73 (21.3)	25(19.8)	48(22.1)	
Refuse but not dissuade the other	68 (19.8)	20(15.9)	48(22.1)	
Dissuade				
Ignore	92 (26.8)	28(22.2)	64(29.5)	

not care; In Xishuangbanna, 90.0 % say they support it, 7.7 % disagree and 2.3 % are indifferent. Talking about a complete ban on eating wildlife and their products, 97.7 % of tourists agree, 1.6 % disapprove and 0.8 % do not care in Zhalong while 92.3 % agreed, 4.1 % disagreed and 3.6 % were indifferent in Xishuangbanna (see Fig. 7).

However, there is a significant difference in the views of the tourists in the two places on how long they would like to implementation the ban on wildlife eating and trading. 78.1 % of the tourists in Zhalong think that permanent ban should be implemented, 14.9 % prefer to long-term ban for 5–10 years or more, and 7.0 % would like to have short-term ban, for 3–5 years or less than 3 years. In Xishuangbanna, the proportions of tourists surveyed for a complete ban, a long-term ban and a short-term ban are 65.5 %, 20.9 % and 13.7 %, respectively (see Fig. 7).

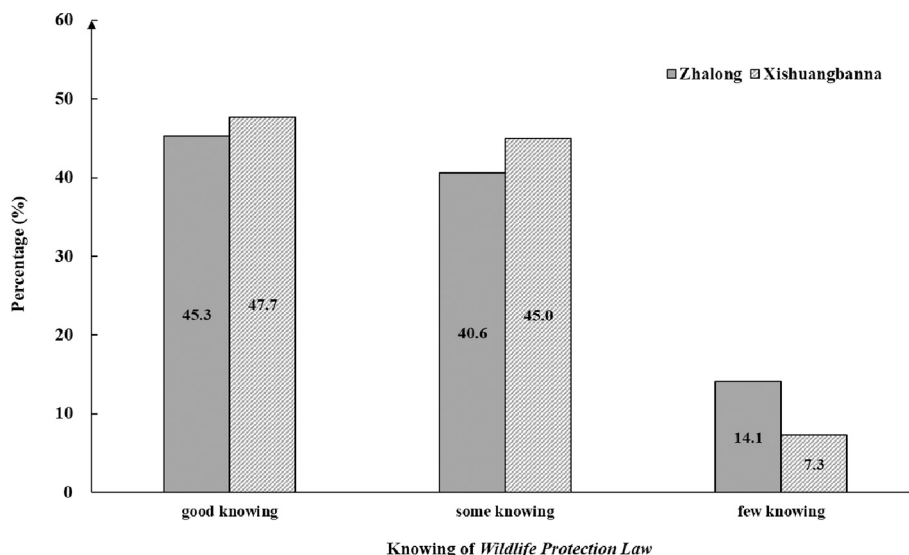
In order to better understand the factors that affect the attitudes of tourists towards legislative proposals, Logit model was used to analyze the 3 attitudes towards legislative proposals among the tourists in the

two nature reserves. With multicollinearity test for each variable, no significant multicollinearity between variables was found (see Table 6). In terms of whether to support a complete ban on the trading in wildlife and their products, there is a tendency in both Zhalong and Xishuangbanna that the better they know about the *Wildlife Protection Law*, the more likely they are to comply with it, and the more likely the tourists who had eaten wildlife tend to say no to wildlife eating. In terms of the lasting time of the ban, test results of the data on the view of Xishuangbanna tourists show that the more diverse the ethnic minorities, the shorter-term ban they would like to have. The small quasi- $R^2$  of each model is related to the small sample size and insufficient explanatory

**Fig. 6.** Tourists' knowing of wildlife species in Zhalong and Xishuangbanna.**Table 3**

Tourists' knowing of wildlife species in Zhalong and Xishuangbanna.

Wildlife species	Zhalong		Xishuangbanna		P value
	n	%	n	%	
Python	106	82.8	159	72.3	<0.05
Tokay gecko	84	65.6	105	47.7	<0.05
Roe deer	111	86.7	149	67.7	<0.05
Pangolin	123	96.1	197	89.5	<0.05
Wild yak	112	87.5	178	80.9	<0.05
Wild camel	111	86.7	175	79.5	<0.05
Tibetan antelope	120	93.8	191	86.8	<0.05
Frog	68	53.1	85	38.6	<0.05
Mallard	91	71.1	137	62.3	<0.05

**Fig. 5.** Tourists' knowing of *Wildlife Protection Law* in Zhalong and Xishuangbanna.

**Table 4**

Tourists' knowledge of wildlife species that can be farmed and consumed even after the pandemic in Zhalong and Xishuangbanna.

Wildlife species	Zhalong		Xishuangbanna		P value
	n	%	n	%	
Sika deer	55	39.8	81	36.8	<0.05
Macaque	6	4.7	16	7.3	
Green Peacock	11	8.6	41	18.6	
Whooper swan	36	28.1	56	25.5	
Mandarin duck	18	14.1	31	14.1	<0.05
<i>Heosemys grandis</i>	4	3.1	15	6.8	
Wolf	6	4.7	17	7.7	<0.05
Ostrich	41	32.0	108	49.1	<0.05
Tiger frog	14	10.9	20	9.1	

**Table 5**

Concerns and Awareness of tourists in Zhalong and Xishuangbanna about zoonotic disease risks that wildlife consumption may induce.

	All(n = 348)	Zhalong (n = 128)	Xishuangbanna (n = 220)	Significance
<b>Do you have increased concerns about wildlife caused zoonotic diseases because of the pandemic</b>				<0.05
Yes	302 (88.3)	116 (92.8)	186(85.7)	
No	40 (11.7)	9(7.2)	31(14.3)	
<b>Do you have increased awareness of the high risk of wildlife consumption in terms of zoonotic diseases</b>				0.727
Yes	322 (95.0)	119 (94.4)	203(95.3)	
No	17 (5.0)	7(5.6)	10(4.7)	

variables that can be collected, and also indicates that the variation of different variables explained in different models is limited and the fitting degree is limited.

## 4. Discussions

### 4.1. Strict enforcement as the primary factor to suppressing wildlife consumption

The strict, diverse, and effective law enforcement is decisive in reducing wildlife consumption [19]. After the outbreak of the pandemic, the Chinese government has responded swiftly with a ban to crack down on illegal trading and eradicate consumption of wildlife [10]. Consequently and accordingly, the relevant authorities as well as provincial government issued policies and measures to enforce the decision. China National Forestry and Grassland Administration (NFGA), State Administration for Market Regulation and Ministry of Agriculture and Rural Affairs (MARA) released in succession the Notice on Regulating the Scope of Classification and Management of Wildlife [20], the Emergency Notice on Wildlife Market Supervision for Pandemic Control [11], and the Notice on Prohibiting Wildlife Trading [21]. In November 2020, the Forestry and Grassland Bureau of Heilongjiang Province issued the Guiding Opinions on Steadily Promoting the Follow-up Work of Banning

Wildlife Eating, requiring on-site investigation of every captive wildlife breeding site to make sure that the species and quantities of wildlife bred, the approval procedures for the captive breeding, and the information of wildlife breeding farmers of every site had been accurately registered [22]. In June 2020, the Office of the People's Government of Yunnan Province issued a notice on cracking down on illegal trading and prohibiting consumption of wildlife, which ceased the administrative license approvals for hunting, breeding, raising, selling, purchasing, and importing/exporting terrestrial wildlife and stopped the wildlife sale, transport and utilization for the purpose of eating [23]. Zhalong and Xishuangbanna Nature Reserve cooperated with the local governments, especially the authorities of market supervision, after the outbreak of the pandemic, for the joint enforcement of wildlife consumption ban, including the patrolling to a larger area with a higher frequency, stop wildlife consumption by mobilizing local rangers, strengthened monitoring of wildlife-caused diseases, close of captive bred wildlife market, etc.

The polices and actions taken after the outbreak of the pandemic have greatly reduced the wildlife consumption around the nature reserves, which is evidenced by our survey. Our study shows that there is a significant transition away from wildlife consumption after the ban and related policy actions against the pandemic. In Zhalong and Xishuangbanna, the percentages of tourists who had eaten wildlife dropped from 8.6 % and 9.5 % before the outbreak to 0 % and 4.1 % after the outbreak, and the proportion of tourists who would possibly buy and eat wildlife if encountering illegal wildlife selling dropped from 6.3 % and 2.7 % before the outbreak both to 0 % after the outbreak. This finding is consistent with the survey conducted by Shi et al. [24], which indicates that the people who had eaten wildlife tend to stop consumption after the outbreak of the pandemic. In our study, the top reason (60.9 % in Zhalong and 45.8 % in Xishuangbanna) that tourists stopped eating wildlife were wildlife consumption ban. This suggests that the strict enforcement of the ban and other wildlife laws and policies plays a key role in this process. This is consistent with the empirical evidence, media coverage and discussions on the online platforms such as Zhihu as well as the academic research by Lin [25] in Nanxiong, Guangdong.

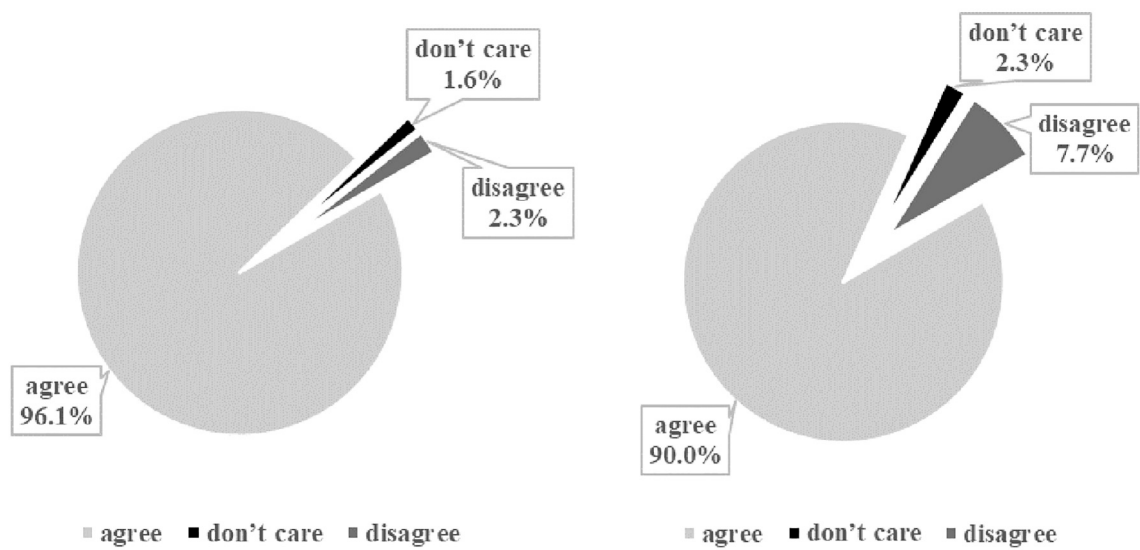
Interestingly, only a small number of tourists (1.3 % in Zhalong and 3.1 % in Xishuangbanna) chose the item of "no way to buy" as the factor affecting their willingness to consume. This means that the cut-off of supply led to a collapse of the previous supply-demand relationship and thus effectively subdued the demand of tourists for the terrestrial wildlife consumption [26–28]. The finding is also opposite to the viewpoints that the ban on wildlife consumption will possibly increase the hidden consumption [17].

### 4.2. Extensive publicity is an essential push to wildlife protection

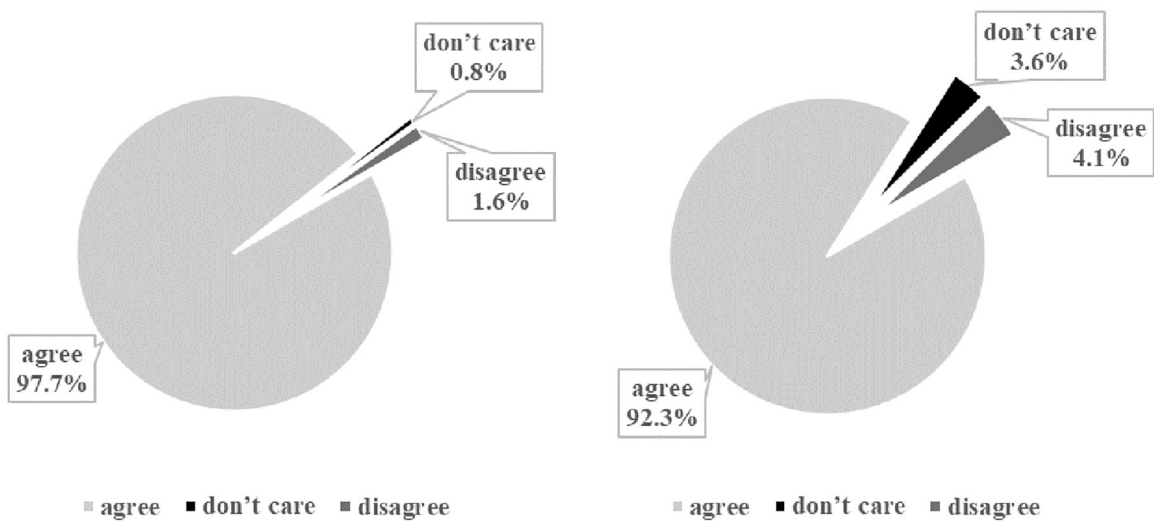
The broad-coverage public publicity and wildlife knowledge dissemination that have been widely promoted in the past 40 years have greatly improve people's awareness, attitudes and subject norm of Chinese people, and the zoonoses that broke out in the past 20 years have brought people to cast concerns of food safety and disease connected wildlife consumption. This high awareness of zoonoses and wildlife protection could attribute to the high-intensity and high-density publicity as well as nature education [29]. This publicity effect is well confirmed by the vigorous publicity by the Chinese government and protected areas authorities at all levels after the outbreak of the pandemic. After the outbreak of COVID-19, the long-time and wide-spread reporting on the ban on all terrestrial wildlife consumption, wildlife-caused zoonosis and wildlife knowledge through various means such as television and radio broadcast, social media like Tiktok, household visit and publicity and community dissemination events [30]. These efforts inevitably affect the public's concepts and attitudes on wildlife protection [31].

It is found that attitude, subjective norm, perceived behavioral control, and past experiences had significant positive effects on

a. Whether to agree to a complete ban on wildlife trade



b. Whether to agree to a complete ban on wildlife consumption



c. Attitudes towards the duration of the ban

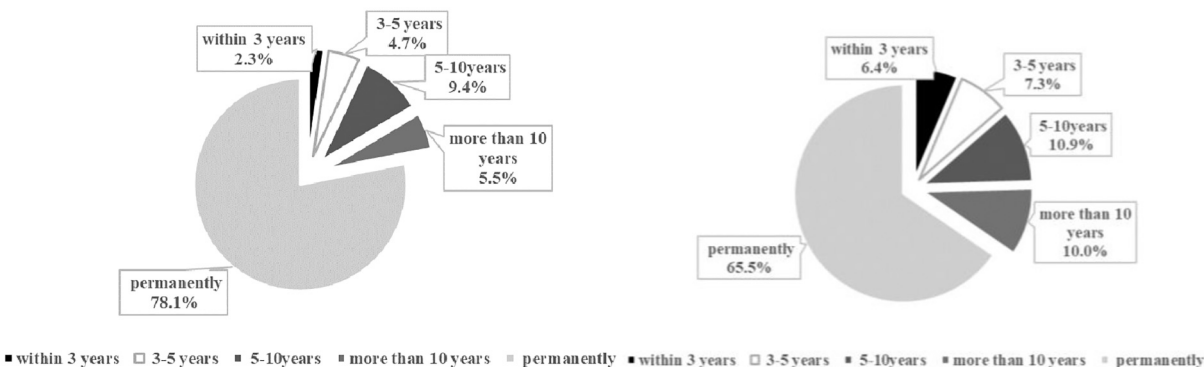


Fig. 7. Attitudes of tourists' in Zhalong (left) and Xishuangbanna (right) towards the ban against wildlife trade and consumption and its duration.



**Table 6**

Estimated Logit model results for influencing factors to attitudes towards legislative motion.

	Complete ban on wildlife trade		Complete ban on wildlife consumption		Period of the ban	
	Zhalong	Xishuangbanna	Zhalong	Xishuangbanna	Zhalong	Xishuangbanna
Tender	−3.317*					
Age						
Education background						
Ethnic						−1.069*
Religious believe						
Type of unit						
Sector						
Annual household income						
Knowledge of wildlife laws	5.617*	4.089*			0.6796*	
Consumption or not before pandemic				−2.959*		
Consumption or not during pandemic	−6.152**	−1.503*		2.922*		

where, \* represents  $P < 0.1$ , \*\* represents  $P < 0.05$ .

resistance intention of wildlife consumption [32], and raising consumers' awareness of food safety would reduce the odds of wildlife consumption [33]. The wide publicity of the dangerous consequences of eating wildlife and the relevant discussion also stimulated the public's concern about wildlife-caused diseases, and people's concerns on food-related risks is increasing, and their willingness to consume wildlife is declining [34,35].

Our research shows that, the tourists have an enhanced willingness to refuse the wildlife eating because of zoonoses after the outbreak of COVID-19. The fear of the zoonosis is the driving forces next to the ban. About 90.0 % of the tourists (92.8 % in Zhalong and 85.7 % in Xishuangbanna) are concerned about connections between the tourists eating of wildlife and zoonotic disease, and about 95.0 % (94.4 % in Zhalong and 95.3 % in Xishuangbanna) recognize that eating wildlife may increase the risk of virus transmission. The vast majority (85.7 %) of tourists who were likely to buy wildlife to eat before the outbreak stopped buying due to the increased concerns about zoonotic diseases. Similarly, when asked about the reason for stopping eating wildlife, about a quarter (25.2 % in Zhalong and 23.1 % in Xishuangbanna) answered that wildlife could transmit diseases. The results correspond well with the earlier study of Si et al. [36], who also found that COVID-19 significantly reduced Chinese peoples' willingness to consume wildlife due to increased awareness of food safety and increased attention to zoonotic diseases caused by wildlife-borne viruses.

Public cooperation is vital for government to strengthen the enforcement. The COVID-19 outbreak has greatly affected the lives of people in China [37], and made Chinese people more aware of the importance of environmental protections [38]. After the outbreak of COVID-19, there are obvious changes in the actions on wildlife conservation among tourists. In general, they have deeper understanding of legal requirements on wildlife and would like to take stronger and positive actions to stop the consumption and trading. The tourists in the two nature reserves show somehow different actions that they would take when encountering illegal wildlife selling. More tourists in Zhalong (61.9 %) than in Xishuangbanna (48.4 %) said that they would not only choose not to buy wildlife and their products, but also dissuade others not to buy and even report the case to the forestry authority. This reflects a higher sense of responsibility among tourists for wildlife protection after the outbreak of COVID-19. The reason behind the difference may be that most of the tourists (68.8 %) in Zhalong come from the three provinces in northeast China, where people have historically been more dependent on state-owned economy, and have the stronger sense of justice and better capacity to participate in public affairs.

These results indicate that China's publicity and dissemination on wildlife related legislation have achieved to a good extent. However, the relatively small number of tourists who have clear understanding and knowledge of the legislative requirements indicates that the current publicity and dissemination are not enough to increase the public's awareness and capacity in their compliance with the law. Through the

interview, it is found that the tourists of different ages have different ways to get the right information on wildlife protection. The elderly are more dependent on the TV and radio, while the young people have more diverse ways to get to know the requirements, and they in turn become the right group to educate the elderly in their family and neighborhood. Therefore, the future dissemination and publicity about wildlife protection requirements should be more targeted and precise in terms of channels, platform, group of ages, contents, etc. How to make young people stay on the same topic through social media like Tiktok will be the future focus.

#### 4.3. More efforts should be taken to improve the public's knowledge of wildlife protection

In the context of increased public awareness on wildlife protection, insufficient knowledge of wildlife has affected the public's perception of how to protect wildlife. Less knowledge about wildlife, may hinder the public to correctly understand the ban and specific provisions of wildlife related laws, regulations and policies.

Our survey finds that tourists' knowledge about the specific requirements of ban on wildlife consumption still needs to be strengthened. The results show that about 90 % of tourists surveyed (85.9 % in Zhalong and 92.7 % in Xishuangbanna) have known the Wildlife Protection Law and relevant regulations and directives after the outbreak, especially the ban on the consumption of all terrestrial wildlife and wildlife products. But about half (40.6 % in Zhalong and 45.0 % in Xishuangbanna) of tourists have no accurate or clear knowledge of the specific requirements of the ban. Another 10 % of the tourists (about 14.06 % and 7.27 % respectively in Zhalong and Xishuangbanna) had no idea about the wildlife consumption ban.

For the question of whether the 10 species given in the questionnaire are wildlife, only about one third of tourists surveyed gave 100 % correct answer, which shows that the tourists have relatively poor recognition of wildlife even after the strong advocacy of wildlife knowledge. Comparatively, the public have very good knowledge of flagship wildlife species under national protection, such as monkey, tiger, leopard, elephant, etc. But they have little idea that some species common in the life are also wildlife under national protection, such as frogs and gecko. The two species are commonly seen in the southern China, and tourists from southern China subconsciously don't equate them to wildlife. The tourists in Zhalong also have the relatively low knowledge about frog, and only 53.1 % know that frog is also a wildlife and should be protected. That may be due to the reality that forest frog is allowed to be bred as food in the northern China.

For species that are allowed to be raised and eaten, the tourists surveyed show a lower knowledge. In 2021, the Ministry of Agriculture and Rural Affairs of the People's Republic of China published the *National List of Livestock and Poultry Genetic Resources* (2021 Edition) [39], which lists the wildlife allowed to be raised and eaten, including sika

deer and ostrich. This study finds that the public have less knowledge about the list. Only about one-third (39.8 % in Zhalong and 36.8 % in Xishuangbanna) of the tourists have the cognition that sika deer is the wildlife species and allowed to be bred for eating. This may be that people usually understand that deer is a protected species and infer that all the deer could possibly be allowed to be eaten. The correct answers to ostrich are of higher rate in both Zhalong (32.0 %) and Xishuangbanna (49.1 %). The reason may be ostrich is an introduced species and people guess it could be eaten.

Another interesting finding is that the tourists' knowledge of wildlife is inconsistent with their self-evaluation of familiarity with *Wildlife Protection Law* and its provisions, especially for the tourists in Xishuangbanna. Only 29.5 % of the tourists in Xishuangbanna give the correct answers for all the wildlife species listed in the questionnaire. This is somewhat different from the rate of the answers on familiarity with the law, i.e., 45.3 % indicating clear understanding of the law and related provisions while only 14.3 % without any idea on the law. Through statistical analysis, their perception and knowledge about the ban actually is not significantly correlated with demographic information such as religion, occupation and place to live, but closely related to the way to know the ban as found in the interviews. Actually, people mainly have 4 ways to know the ban on wildlife consumption, i.e., traditional media like TV and radio, social media, school and community-based wildlife education, and words of mouth. The traditional media and school and community-based wildlife education have given a thorough, systematic and in-depth explanation of wildlife protection related laws and their specific requirement on wildlife consumption, while social media, especially the short video, and words of mouth only gave the fragmented information of the wildlife consumption ban without any systematic presentation of specific law requirements. This may explain the difference between tourists' knowledge of wildlife and their self-evaluation of familiarity with the ban.

In this sense, sufficient and effective education/dissemination/publicity of wildlife knowledge is necessary. The coexistence of traditional media and new social media while the out-performance of new social media over traditional media provides the opportunity, and the emerging social media is a promising means of strengthening public awareness, especially the concise but lively news like Tiktok [31]. But that does not mean the new social media should replace the traditional media. The interviews found that young people got the knowledge about wildlife and wildlife protection from social media, while middle-aged and elderly people rely more on traditional media such as TV and their families for the knowledge.

Therefore, how to integrally use the traditional media and social media has become an important topic in wildlife knowledge publicity. In the context, the short, quick, broad and diverse pushes of social media should be fully taken advantage of to attract public attention to wildlife conservation, and the content of traditional social media should be redirected to social media to ensure the accuracy and depth of social media reporting and reduce the spread of false information. The integrated use of both traditional media and new social media will help people to form multidimensional thinking for wildlife protection [31], and establish a sound public environment for science-based decision-makings and actions on wildlife.

#### 4.4. More rational attitudes required for complete ban on wildlife utilization

The ban that was quickly issued and strictly enforced after the outbreak of COVID-19 [40] has won the strong support from the public. Since the 2003 outbreak of zoonotic SARS, China has established a policy framework to control wildlife markets [41]. The 2016 Wildlife Protection Laws only prohibited the eating of the terrestrial and aquatic wildlife that are rare, valuable and endangered [41], which only covers 406 species [42]. As far as public health is concerned, many species

serve as reservoirs for zoonotic diseases, thereby posing a health risk to humans [43]. Immediately after the outbreak, public opinion against wildlife utilization that is unsustainable, illegal, or carries significant risks to human health helped produce mandates for policy change [44]. In a survey of Chinese public opinion on wildlife trade and consumption carried out in February 2020, 96.2 % favored legislation to ban the eating of wildlife, and 95.1 % were in favor of legislation to prohibit the trading of wildlife and their products [24].

However, some people do not agree with banning all the use and trade of wildlife, or blanket measures for entire Classes. Throughout Chinese history, animals have been interpreted or used for spiritual purposes or as an intellectual, economic, socio-political, or physical resource, and they also have been regarded as moral values. Historically, human-wildlife relationship in China had multiple dimensions, including utilitarian, sentimental, and sympathetic attitudes—which often co-existed—towards animals [44]. The consumption of wildlife is not uncommon in many parts of the world, and in many cases is a very important part of cultural identification [45,46].

In addition, China's wildlife farming industry created 6.3 million jobs and a total output value of \$18 billion [47]. Curtailing this activity in a short period of time will be difficult for the large number of practitioners, bringing them into the difficult situation and huge economics losses. Conflicts may occur between the private interests of farmers and public interests in health. Indeed, the unintended consequences of bans on wildlife trade have been well rehearsed in the literature [48]. For example, following the Ebola outbreak in West Africa in 2013–2016, the trade was banned, and public health messaging suggested that wildlife should not be eaten. The trade did not stop but was pushed underground and people's trust in authorities was undermined by the mismatch between their own experience and official guidance [17]. This reaction has also been documented after Ebola outbreaks in Guinea and Nigeria [49,50].

The results of this study also show that the vast majority of respondents (96.1 % and 97.7 % in Zhalong and 90.0 % and 92.3 % in Xishuangbanna) are in favor of a complete ban on the wildlife trading and consumption, while 2.3 % of tourists in Zhalong and 7.7 % in Xishuangbanna are not in favor of a complete ban on wildlife trading, 1.6 % in Zhalong and 4.1 % in Xishuangbanna disapprove a complete ban on consumption wildlife. It is interesting to observe that the tourists disapproving a complete ban on wildlife trading and consumption have a higher education level. Those who express their disapproval in Zhalong all have bachelor's degree or above, and most of them engage education and scientific research, while in Xishuangbanna 77.8 % of those who held disapproval attitude have a bachelor's degree or above, and 41.2 % of them work in primary industries such as agriculture, forestry and fishery as well as environment protection research. This suggests that people with higher education or working in wildlife-related sectors are more likely not to support a complete ban on the trading and consumption of wildlife. The study of Shi et al. [24] also show that groups engaged in wildlife breeding and utilization are more likely than other groups not to support a complete ban on wildlife trade and consumption.

Even though the tourists surveyed from the south have a stronger support to the ban on wildlife consumption and trading, they have lower inclination (65.5 % in Xishuangbanna) for the permanent ban, while the tourists from the north have more determined willingness (78.1 % in Zhalong) to support the permanent ban, outpacing the tourists from the south by more than 12 percentage points. It is also interesting to see that the tourists from the south have the better understanding of wildlife laws and wildlife consumption ban, which is consistent with the results that more knowledge of wildlife have cautious attitudes towards the permanent ban.

As China has strengthened the protection and restoration of natural ecosystems such as forests and grasslands, the species and population of wildlife in and around the protected areas have grown rapidly, and some species even reach the maximum quantities that nature reserves allow

for. These have been increasing cases of wildlife caused asset/life loss [51–53].

In this context, the tourists with high education and ecological background and more knowledge about wildlife are not in favor of long-term and permanent ban on wildlife consumption. Their main concerns are the conflict between human and wildlife, the rationality of wildlife farming and the employment and livelihood created by wildlife farming industry. They support to adjust the list of wildlife under national protection and move out the species with excessively large population and adopt the science-based hunting and consumption to maintain the proper ratio of wildlife-environment carrying capacity.

When our survey was completed, the Wildlife Protection Law, amended in 2022, came into force on 1 May 2023 [54]. The law has significant changes in four aspects: 1) The terrestrial wildlife with important ecological, scientific, and social values are included in the scope of emergency rescue; 2) Ex situ protection and hunting for species whose population significantly exceeds the environmental carrying capacity is allowed; 3) The management of wildlife introduced abroad is regulated, especially for wildlife releasing and discarding activities; and 4) The captive breeding of wildlife under national protection but with mature and stable breeding technology is further regulated, and the different management approaches between captive bred population and wild population are adopted. In June 2023, the National Forestry and Grassland Administration announced the newly adjusted List of Terrestrial Wildlife of Important ecological, scientific and social Value, removing wild boar, civet and other species that have a large population. This shows that China is adopting a science-based dynamic approach to wildlife protection and management.

However, in the Logit model analysis of the influential factors of legislative motion in this study, the sectors have no significant impact on legislative motion, which may be due to the fact that we set the sectors as too many options in the questionnaire, and the sample size of this study is not large, so the statistical results have no significant impact, which is also a limitation of this study. Another limitation is that when the questionnaire survey was carried out, the COVID-19 situation was still under control in China, and the number of tourists was limited, resulting in a low sample size for this study. In addition, the translation of some English words and Western understandings such as “wildlife” could be problematic in China because of different historical rationales for eating wildlife in Chinese and Western conceptions and cultures. Therefore, our findings should be interpreted cautiously.

## 5. Conclusions

In conclusion, strict enforcement is the primary factor to suppressing wildlife consumption, and extensive publicity is an essential push to wildlife protection. The supply is cut off because of strict enforcement and close of wildlife farmers and market, while widespread publicity make tourists tend to refuse to consume wildlife out of the fear of law violation and zoonoses, which reduced the demand for wildlife. More important, tourists have a higher sense of responsibility for wildlife protection after the outbreak of COVID-19, more than 50 % tourists (61.9 % in Zhalong and 48.4 % in Xishuangbanna) would like to take more proactive action than only refusing to buy wildlife, such as reporting to forestry authorities and dissuading others from buying wildlife when encountering illegal wildlife selling. However, it is found that more efforts should be taken to enhance the tourists' knowledge of wildlife and wildlife laws. Even though about 90 % tourists (85.9 % in Zhalong and 92.7 % in Xishuangbanna) know about the legal requirements, about half of tourists (40.6 % in Zhalong and 45.0 % in Xishuangbanna) have no clear idea about the specific provisions. In terms of geography, the tourists from the north show stronger obedience to government requirements but have less knowledge of wildlife consumption ban and other related policies. Even though the tourists from the south have the more knowledge of wildlife laws and wildlife consumption ban, they have lower inclination (65.5 % in Xishuangbanna) to

support the permanent ban. The tourists surveyed with higher education or those working in wildlife-related sectors have cautious attitudes towards the complete and permanent wildlife consumption ban.

## Author contributions

Data curation, Qiu He; Formal analysis, Wenjuan Yang and Yawen Zhang; Investigation, Qiu He, Lu Wang, Yafei Wang, Wang Liao, Wei Ji and Jie Chen; Project administration, Jie Chen; Writing – original draft, Wenjuan Yang; Writing – review & editing, Jie Chen.

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## CRediT authorship contribution statement

**Wenjuan Yang:** Writing – original draft, Formal analysis. **Qiu He:** Investigation, Data curation. **Lu Wang:** Investigation. **Yafei Wang:** Investigation. **Wang Liao:** Investigation. **Wei Ji:** Investigation. **Yawen Zhang:** Formal analysis. **Jie Chen:** Writing – review & editing, Project administration, Investigation.

## Declaration of competing interest

The authors declare no conflict of interest.

## Data availability

The datasets generated and analyzed during the current study are not publicly available but are available from the corresponding author on reasonable request.

## References

- [1] WHO, Coronavirus Disease 2019 (COVID-19) Situation Report—94, 2020 [cited 2022 08 July]; Available from: [https://www.who.int/docs/default-source/coronavirus/situation-reports/20200423-sitrep-94-covid-19.pdf?sfvrsn=b8304bf0\\_4](https://www.who.int/docs/default-source/coronavirus/situation-reports/20200423-sitrep-94-covid-19.pdf?sfvrsn=b8304bf0_4).
- [2] O.R. Vinodhkumar, K. Ram, B.S. Pruthivishree, et al., SARS-CoV-2 (COVID-19): zoonotic origin and susceptibility of domestic and wild animals, *J. Pure and Appl. Microbiol.* 14 (2020) 741–747, <https://doi.org/10.22207/JPAM.14.SPL1.11>.
- [3] WWF, COVID-19 and Wildlife Trade: Perspectives and Proposed Actions, 2020 [cited 2022 11 October]; Available from: <https://www.worldwildlife.org/pages/covid-19-and-wildlife-trade-perspectives-and-proposed-actions>.
- [4] P.F. Rupani, M. Nilashi, R.A. Abumalloh, et al., Coronavirus pandemic (COVID-19) and its natural environmental impacts, *Int. J. Environ. Sci. Technol.* 17 (2020) 4655–4666, <https://doi.org/10.1007/s13762-020-02910-x>.
- [5] W.B. Karesh, R.A. Cook, E.L. Bennett, et al., Wildlife trade and global disease emergence, *Emerg. Infect. Dis.* 11 (2005) 1000–1002, <https://doi.org/10.3201/eid1107.050194>.
- [6] G.Y. Wei, Food safety issues related to wildlife have not been taken seriously from SARS to COVID-19, *Environ. Res.* 186 (2020) 1–2, <https://doi.org/10.1016/j.envres.2020.109605>.
- [7] H.X. Wang, J.L. Shao, X. Luo, et al., Wildlife consumption ban is insufficient, *Science* 367 (2020) 1435, <https://doi.org/10.1126/science.abb6463>.
- [8] J.W. Chang, J.Z. Chang, China needs to establish a directory system of wildlife prohibited from hunting, Breeding, Transferring or Eating Urgently, *Derecho Animal Forum of Animal Law Studies* 11 (2020) 59–64, <https://doi.org/10.5565/rev.da.479>.
- [9] X.M. Zhao, P.A. Garber, M. Li, Alleviating human poverty: a successful model promoting wildlife conservation in China, *Conserv. Sci. Pract.* 3 (2021) 1–8, <https://doi.org/10.1111/csp2.511>.
- [10] Xinhua, China's legislature adopts decision on banning illegal trade, consumption of wildlife, 2020 [cited 2023 08 March]. Available from: [http://www.china.org.cn/china/2020-02/25/content\\_75740946.htm](http://www.china.org.cn/china/2020-02/25/content_75740946.htm).
- [11] State Administration for Market Regulation, Market regulators across the country moved quickly, Strengthen supervision of wildlife markets, 2020 [cited 2024 08 November]. Available from: [https://www.samr.gov.cn/xw/zj/art/2023/art\\_8c05377d1da8405eb3773c87e58ff06.html](https://www.samr.gov.cn/xw/zj/art/2023/art_8c05377d1da8405eb3773c87e58ff06.html).
- [12] Report South China Today, There are still people in Guilin want to eat wildlife, 2020 [cited 2024 08 November]; Available from: <https://baijiahao.baidu.com/s?id=1659911513329305651&wfr=spider&for=pc>.



- [13] Sina News, Some fish restaurants in Zhalong National Nature Reserve Harbin openly sell wildlife, 2001 [cited 2024 01 November]; Available from: <https://news.sina.com.cn/s/261393.html>.
- [14] CHINANEWS, A man in Xishuangbanna was caught by plainclothes forest police while selling wildlife at high prices at market, 2015 [cited 2024 01 November]; Available from: [http://news.cnr.cn/native/gd/20151201/t20151201\\_520656464.shtml](http://news.cnr.cn/native/gd/20151201/t20151201_520656464.shtml).
- [15] D. Casey, P.J. Chen, S.A. Justine, et al., Conflict on the range: evaluating driving factors of attitudes toward prey species in Qilianshan, J. Res. Ecol. 9 (2018) 554–565, <https://doi.org/10.5814/j.issn.1674-764x.2018.05.013>.
- [16] H.B. Liu, Wildlife protection in the ecotourism development from the perspective of biocentrism, Journal of Anhui, Agric. Sci. 40 (2012) 2121–2123, <https://doi.org/10.3969/j.issn.0517-6611.2012.04.078>.
- [17] J. Bonwitt, M. Dawson, M. Kandeh, et al., Unintended consequences of the 'bushmeat ban' in West Africa during the 2013–2016 Ebola virus disease epidemic, Soc. Sci. Med. 200 (2018) 166–173, <https://doi.org/10.1016/j.socscimed.2017.12.028>.
- [18] Central Government of the People's Republic of China, Transcript of press conference of the Joint Prevention and Control Mechanism of The State Council on December 27, 2022 [cited 2024 08 November]; Available from: <http://www.nhc.gov.cn/xcs/s3574/202212/6bbb3d534e3c49f992f9eaa5a45fc7a2.shtml>, 2022.
- [19] Wang, J., et al., S.J. Wang, X. Luo, Protection law enforcement mechanism in China: Problems, causes and countermeasures, J. Jiangxi Normal Univ.Sci. Technol. 2 (2021) 67–73, <https://doi.org/10.3969/j.issn.1007-3558.2021.02.009>.
- [20] Central Government of the People's Republic of China, Notice of the State Forestry and Grassland Administration on Regulating the Scope of Classification and Management of fasted wildlife [cited 2024 08 November]; Available from: [https://www.gov.cn/zhengce/zhengceku/2020-10/06/content\\_5549490.htm](https://www.gov.cn/zhengce/zhengceku/2020-10/06/content_5549490.htm), 2020.
- [21] Central Government of the People's Republic of China, The State Administration for Market Regulation, the Ministry of Agriculture and Rural Affairs and the National Forestry and Grassland Administration jointly issued a notice banning wildlife trade [cited 2024 08 November]; Available from: [https://www.gov.cn/zhengce/zhengceku/2020-01/26/content\\_5472280.htm](https://www.gov.cn/zhengce/zhengceku/2020-01/26/content_5472280.htm), 2020.
- [22] Heilongjiang Forestry and Grassland Administration, Policy interpretation of the Guiding Opinions on the Follow-up Work of fasting wildlife [cited 2024 08 November]; Available from: [http://lyhcyj.hlj.gov.cn/lyhcyj/c107224/202011/c00\\_30884841.shtml](http://lyhcyj.hlj.gov.cn/lyhcyj/c107224/202011/c00_30884841.shtml), 2020.
- [23] General Office of the Yunnan Province, Notice of the General Office of the Yunnan Province on comprehensively prohibiting the illegal wildlife trading and consumption [cited 2024 08 November]; Available from: [https://www.yn.gov.cn/zwgk/zfgb/2020/2020d14q/szfbgtwj/202006/t20200622\\_205934.html](https://www.yn.gov.cn/zwgk/zfgb/2020/2020d14q/szfbgtwj/202006/t20200622_205934.html), 2020.
- [24] X.Y. Shi, X.C. Zhang, L.Y. Xiao, et al., Public perception of wildlife consumption and trade during the COVID-19 outbreak, Biodivers. Sci. 28 (2020) 630–643, <https://doi.org/10.17520/biods.2020134>.
- [25] J.F. Lin, Reflection: an update on China's wild meat consumption since COVID-19, Food and Foodways 29 (2021) 213–222, <https://doi.org/10.31838/srp.2020.9.53>.
- [26] Z.J. Liang, J.B. Hu, S.F. Hu, et al., Understanding and changing wildlife consumption behavior from a multidisciplinary perspective, Biodivers. Sci. 28 (2020) 606–620, <https://doi.org/10.17520/biods.2020135>.
- [27] Y.S. Zhao, China eyes end to eating wildlife despite no evidence showing COVID-19 comes from wildlife farms in S. China, 2021 [cited 2024 04 November]; Available from: <https://www.globaltimes.cn/page/202104/1220613.shtml>.
- [28] Wang, A.L. Wang, R. Feng, Analysis of consumer behavior under a public health emergency — Take COVID-19 as an example, J. Xi'an Petroleum Univ. (Social Science Edition) 29 (2020) 55–61, <https://doi.org/10.3969/j.issn.1008-5645.2020.06.007>.
- [29] X.H. Zhou, X.T. Wan, Y.H. Jin, et al., Concept of scientific wildlife conservation and its dissemination, Zool. Res. 37 (2016) 270–274, <https://doi.org/10.13918/j.issn.2095-8137.2016.5.270>.
- [30] Z. Song, Q. Wang, Z. Miao, et al., The impact of information on attitudes toward sustainable wildlife utilization and management: a survey of the Chinese public, Animals 11 (2021) 2640–2656, <https://doi.org/10.3390/ani11092640>.
- [31] Y.L. Wu, L. Xie, S.L. Huang, et al., Using social media to strengthen public awareness of wildlife conservation, Ocean Coast. Manag. 181 (2018) 76–83, <https://doi.org/10.1016/j.ocecoaman.2017.12.010>.
- [32] Z. Zhang, T. Yang, Y. Hu, et al., Behavioral intention to resist the consumption of wild animals in China: netizen survey, Diversity 14 (2022) 343.
- [33] Z. Li, H. Wang, Consumer behavior and wild animal consumption in China, Chin. Econ. 54 (2021) 389–401, <https://doi.org/10.1080/10971475.2021.1890357>.
- [34] S.A. Orlando, A. Perez, E. Sanchez, et al., High seroprevalence of anti-Leptospira spp. antibodies in domestic and wild mammals from a mixed use rescue center in Ecuador: lessons for "one health" based conservation strategies, One Health 10 (2020) 100140, <https://doi.org/10.1016/j.onehlt.2020.100140>.
- [35] L.A. Eaton, S.C. Kalichman, Social and behavioral health responses to COVID-19: lessons learned from four decades of an HIV pandemic, J. Behav. Med. 2020 (43) (2020) 341–345, <https://doi.org/10.1007/s10865-020-00157-y>.
- [36] R.S. Si, Q. Lu, N. Aziz, Impact of COVID-19 on peoples' willingness to consume wild animals: empirical insights from China, One Health 12 (2020) 100240, <https://doi.org/10.1016/j.onehlt.2021.100240>.
- [37] J. Yuan, Y. Lu, X. Cao, et al., Regulating wildlife conservation and food safety to prevent human exposure to novel virus, Ecosyst. Health Sustain. 6 (2020) 5, <https://doi.org/10.1080/20964129.2020.1741325>.
- [38] S.C. Liu, Z.F. Ma, Y.T. Zhang, et al., Attitudes towards wildlife consumption inside and outside Hubei Province, China, in relation to the SARS and COVID-19 outbreaks, Hum. Ecol. 48 (2020) 749–756, <https://doi.org/10.1007/s10745-020-00199-5>.
- [39] Ministry Agriculture and Rural Affairs of the People's Republic of China, Notice on the publication of the National Breed List of Livestock and Poultry Genetic Resources [cited 2022 04 December]; Available from: [http://www.moa.gov.cn/govpublic/nybzj1/202101/t20210114\\_6359937.htm](http://www.moa.gov.cn/govpublic/nybzj1/202101/t20210114_6359937.htm), 2021.
- [40] P.K. Lian, Y.H. Li, J.H. Lee, The value of China's ban on wildlife trade and consumption, Nat. Sustain. 19 (2021) 2–4, <https://doi.org/10.1038/s41893-020-00677-0>.
- [41] N. Yang, P. Liu, W. Li, et al., Permanently ban wildlife consumption, Science 367 (2020) 1434, <https://doi.org/10.1126/science.abb1938>.
- [42] Weisit of China Court, The definition and identification of wildlife under the system of total prohibition of eating wildlife, 2020 [cited 2024 05 November]; Available from: <https://www.chinacourt.org/article/detail/2020/03/id/4870633.shtml>.
- [43] B.T. Plourde, T.L. Burgess, E.A. Eskew, et al., Are disease reservoirs special? Taxonomic and life history characteristics, PLoS One 12 (2017) e0180716, <https://doi.org/10.1371/journal.pone.0180716>.
- [44] J. Xu, F.Q. Mei, C.T. Lu, COVID-19, a critical juncture in China's wildlife protection? Hist. Philos. Life Sci. 43 (2021) 1–4, <https://doi.org/10.1007/s40656-021-00406-6>.
- [45] G. Volpato, M.F. Fontefrancesco, P. Gruppato, et al., Baby pangolins on my plate: possible lessons to learn from the COVID-19 pandemic, J. Ethnobiol. Ethnomed. 16 (2020) 1–12, <https://doi.org/10.1186/s13002-020-00366-4>.
- [46] P.A. Lindsey, G. Balme, M.S. Becker, The bushmeat trade in African savannas: impacts, drivers, and possible solutions, Biol. Conserv. 160 (2013) 80–96, <https://doi.org/10.1016/j.biocon.2012.12.020>.
- [47] Chinese Academy of Engineering, Report on sustainable development strategy of China's wildlife farming industry, 2017 [cited 2023 04 January]. Available from: <https://www.docin.com/p-2301617394.html>.
- [48] J. Mcnamara, E.J.Z. Robinson, K. Abernethy, et al., COVID-19, systemic crisis, and possible implications for the wild meat trade in sub-Saharan Africa, Environ. Resour. Econ. 76 (2020) 1045–1066, <https://doi.org/10.1007/s10640-020-00474-5>.
- [49] L. Duonamou, A. Konate, S. Djego, et al., Consumer perceptions and reported wild and domestic meat and fish consumption behavior during the Ebola epidemic in Guinea, West Africa, PeerJ 8 (2020) 1–24, <https://doi.org/10.7717/peerj.9229>.
- [50] S. Friant, S.B. Paige, T.L. Goldberg, et al., Drivers of Bushmeat hunting and perceptions of Zoonoses in Nigerian hunting communities, PLoS Negl. Trop. Dis. 9 (2015) 1–16, <https://doi.org/10.1371/journal.pntd.0003792>.
- [51] D. Yin, Z.J. Yuan, J. Li, Mitigate human-wildlife conflict in China, Science 373 (2021) 500–501, <https://doi.org/10.1126/science.abj8766>.
- [52] K.W. Su, J. Ren, Y. Huang, et al., Current status, challenges and advices of human wildlife conflict management in protected area, Chin. J. Wildlife 43 (2022) 259–265, <https://doi.org/10.3969/j.issn.1000-0127.2022.01.041>.
- [53] Q.M. Cui, Can tourism mitigate human-wildlife conflict in protected area? J. Chin. Ecotourism 11 (2021) 663–675, <https://doi.org/10.12342/zgstly.20210078>.
- [54] National Forestry and Grassland Administration, Wildlife Protection Law of the People's Republic of China [cited 2024 04 November]; Available from: <https://www.forestry.gov.cn/c/www/gklcl/300028.jhtml>, 2022.