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Evaluating the Public Knowledge on the Use of Endangered Species in Producing Traditional Medicines

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This study was conducted by project team of students from University of Hong Kong (HKU), and the Japan Wildlife Conservation Society (JWCS), which is a non-profit organization located in Tokyo, Japan. While the survey in Japan has been completed with the support of our university collaborators, we were unable to obtain as many survey responses as we had expected in Hong Kong and Macau due to the situation of COVID-19. JWCS finished a statistical analysis on behalf of the students who graduated without completing this research satisfactorily due to physical closures of the university. It is unfortunate, therefore, that the collaboration of this research ended satisfactorily. We strongly hope, however, that the international cooperation could be maintained so that they are able to liberally conduct future research activities taking into account the threats to academic freedom currently faced in Hong Kong.

[Summary]

A questionnaire survey was conducted on university students in Japan and Hong Kong/Macau (i.e. higher education students) regarding the use of endangered species used in the production of traditional medicines. We found that respondents from both areas considered traditional medicine to be necessary, and indeed had use experience of using them. The general view of the respondents showed negative views regarding the use of endangered species in the production of traditional medicines. However, they did not care about presence/absence of endangered species in traditional medicines they take. In other words, there was little interest and awareness about the ingredients of the traditional medicines used and/or the use of endangered species. Most respondents also supported the use of alternatives to endangered species. On the other hand, even though respondents from Hong Kong/Macau were more aware of endangered species being in the production of traditional medicines, they were more in favor of the use of endangered species than respondents from Japan. Given this result in terms of reducing the demand for endangered species, it is likely that the respondents of the survey would avoid medicines containing endangered species if they are informed of the presence of endangered species in the medicines and their alternatives to traditional medicine.

JAPAN WILDLIFE CONSERVATION SOCIETY

Introduction

Since ancient times, various animals and plants have been used as ingredients for traditional medicines. Since the use has evidently led to many species becoming extinct or endangered, a change of consumer behavior is required. Young people being the next generation of consumers, are said to have a strong interest in environmental issues, thus the demand for these traditional medicines may differ across different age groups in society. From the aspect of wildlife conservation, it is therefore essential to understand changes in demand and consumption. In this study, we surveyed and analyzed the awareness of this theme among university students (higher education students) in Japan, Hong Kong and Macau.

Materials and methods

1. Respondents

A website was created for collecting questionnaire survey responses including explanations of the research in English, Japanese, and Chinese, which made it possible for a respondent to answer the survey form anonymously. The website was made accessible from any personal computer or mobile phone with internet connection. The student research group from the University of Hong Kong explained the purpose of the questionnaire to respondents and called for an answer directly at Teikyo University of Science and Kokugakuin University from January 7th, 2020 to January 10th, 2020, and an online meeting with students at Rakuno Gakuen University. Collecting responses in Japan was conducted from December 19th, 2019 to January 15th, 2020. The respondents were students belonging to Kokugakuin University, Teikyo University of Science, Rikkyo University, Rakuno Gakuen University, and the Japan Youth Biodiversity Network. In Hong Kong/Macau, we collected responses in a similar way from higher education institutions in Hong Kong through emails and SNS from November 8th, 2019 to February 29th, 2020.

2. Questionnaire item

The place of origin, age, and sex were provided by respondents so as to inform the demographic background of respondents. In turn, questions were asked to understand the users' perspectives on the topic of traditional medicines: 1) experience of using traditional medicines, 2) experience of using traditional medicines which contained ingredients from endangered species, 3) opinions on which age group the respondent thinks uses the most traditional medicines containing ingredients from endangered species, 4) endangered species used in traditional medicines that the respondent and

his/her family has previously taken, 5) species which the respondent are aware of being used in traditional medicines. Respondents answered the last two questions (i.e. 4 and 5) using a list of species we provided (see below). As a survey to test the attitude of respondents, 6) the necessity of traditional medicines, 7) the necessity of endangered species in traditional medicines, and 8) the attitude on using alternative medicines were asked on the questionnaire (see Appendix).

Fourteen species used in the production of traditional medicines we included in our list are from Appendix I in CITES. These species were grouped into three categories: A) species in CITES Appendix II (international trade is allowed only under permission), B) species in CITES Appendix I (international trade is not allowed), and C) species being used in specific areas as traditional medicines.

A) Appendix II

This group includes the bear (*Ursidae spp.*), musk deer (*Moschus spp.*), saiga antelope (*Saiga tatarica*), seahorse (*Hippocampus spp.*), tokay gecko (*Gekko gecko*). All bear species are listed in Appendix II with the exception of Asian black bear and some species of brown bear listed in Appendix I. An export permit issued by the management authorities in the export country is required, with the advice from the Scientific Authorities in the export country that export will not lead to circumstances threatening the species survival in order to import these species.

Bear bile is used in medicines for digestive system. Researchers in the University of Okayama in Japan identified the principal ingredient of bear bile, ursodeoxycholic acid, which has been chemically synthesized and sold as an over-the-counter drug (OTC, Yoshiyuki 2020). Although Watanabe *et al*. (2009) found cow bile contains the same medical effect as bear bile, 86 medicines containing bear bile were still listed in the "Japan pharmaceutical data book: over-the-counter drug" (October 2018 version) by Jiho Inc. Secretions from musk glands of musk deer located at the abdomen is called "musk" and is used for medical or aromatic chemical purposes. All musk deer families are listed as Appendix II and some species are even listed under Appendix I. Yamada Pharmaceutical Co., Ltd. (provisional translation) redesigned a medicine which does not contain musk due to its difficulty to access (Yamada Pharmaceutical Co., Ltd. 2015). Horns from saiga antelopes are used in OTCs and one type of them is also seen in a television commercial. Seahorses are used in commercially-sold nutritional drinks. Tokay geckos were listed in Appendix II since December 26th, 2019.

B) Appendix I

Rhinoceros (*Rhinocerotidae spp.*), tigers (*Panthera tigris*), leopards (*Panthera pardus*), lions (*Panthera leo*), elephants（*Elephantidae*), pangolins (*Manis spp.)*, and totoabas (*Totoaba macdonaldi*) are listed in Appendix I. Since international trade is not generally allowed for species in Appendix I, medicines made from these species are illegal unless it was produced before the introduction of the CITES regulation.

Importation of rhino horn has been prohibited since Japan joined CITES in 1980. Therefore, some pharmaceutical companies have used saiga's horn as an alternative which is believed to hold the same effectiveness (TRAFFIC 2016). Although liquor-preserved tiger bone has been used as a tonic medicine, due to the decreased population of tigers, it is understood that demand for other large cat species have been driven up as a result (EIA 2020, TRAFFIC 2015). Pangolins have been listed in Appendix I since January 2nd, 2017. Totoabas are widely sold as a luxury seafood for its alleged medical benefits.

C) Species being used in specific area as traditional medicines

This group includes the Japanese pond turtle (*Mauremys japonica*) and slow loris (*Nycticebus spp.*). The Japanese pond turtle have been listed under Appendix II since June 12th, 2013 and its exporting has been prohibited because approximately 28,000 individuals were applied for shipping from August 2nd, 2015 to September 13th, 2015 (Ministry of the Environment 2015). Destinations for export of the pond turtle mainly consists of mainland China and Hong Kong. Slow loris is believed to be effective for postpartum recovery, treating sexually transmitted diseases, and asthma in Cambodia and Vietnam. But its use is limited to specific areas (JWCS 2010).

We listed the names and showed pictures of these species which have been used in the production of traditional medicines to survey respondents. In turn, respondents were asked if they have used any such medicines or if they were aware of these species being used as traditional medicine ingredients.

Table 1. Example of medicines containing endangered species in our list and its medical effect

Category	Species	Medicine name	Medicinal effect	Body part	Effect of active ingredient	Ref.
A	Bear	ウチダの熊胆, 紀伊国屋ユウタン, 救胆 etc.	digective system	bile	stomachic and choleretic actions	1
A	Bear	永春丸, 延壽麝龍散, 延命一心丸 etc.	circulatory system	bile	stomachic and choleretic actions	1
A	Bear	延寿太陽丸, 奥田胃腸薬L, 丸剤熊膽圓S etc.	digective system	bile	stomachic and choleretic actions	1
A	Musk deer	新大宝心, 心薬, 精改心 etc.	circulatory system	musk gland	overactive cardiac	1, 2
A	Musk deer	特撰金粒樋屋奇応丸	neuropsychiatric	musk gland	hypercardiac, hypotensive, male hormone-like, anti-inflammatory actions	1, 2
A	Musk deer	日野実母散	gynecologic	musk gland	hypercardiac, hypotensive, male hormone-like, anti-inflammatory actions	1, 2
A	Saiga antelope	いけだや牛黄麝龍圓	circulatory system	horn	central nervous system depressive, antipyretic, analgesic actions	1, 2
A	Saiga antelope	宇津救命丸, キンキ奇応丸, 五黄圓 etc.	neuropsychiatric	horn	central nervous system depressive, antipyretic, analgesic actions	1, 2
A	Saiga antelope	日水清心丸, 馬場安寿丸, 能活精 etc.	analeptic	horn	central nervous system depressive, antipyretic, analgesic actions	1, 2
A	Sea horse	春源精, 新ロクジュウオウA, 日水補腎片 etc.	analeptic	whole	male hormone-like action	1, 2
A	Tokay gecko	秦皇元（カプセル）, 新ロクジュウオウA	analeptic	whole	androgenic action	1, 2
B	Rhinoceros	赤井筒薬小児六神丸, 岡平小児感應丸	circulatory system	horn	cardiotonic, vasopressor actions	1, 2
B	Rhinoceros	救寿, 救命散, 済仁, 和平六神丸	circulatory system	horn	cardiotonic, vasopressor actions	1, 2
B	Tiger	腎白金, 硬十天, 速勃延时片 etc.	-	bone	anti-inflammatory, analgesic actions	1, 2
B	Leopard	健歩強身丸	-	bone	-	3
B	Lion	-	-	bone	-	3
B	Elephant	-	-	ivory	-	3
B	Pangolin	七草五毒膏,炮山甲　美国魔根	-	scale	rheumatism, arthralgia, tumour, hypogalactia	2, 3
B	Totoaba	-	-	air bladder	-	-
C	Japanese pond turtle	-	-	lower shell	-	4
C	Slow loris	-	-	whole	postpartum recovery, sexually transmitted disease, asthma	5

1) Japanese Pharmaceuticals DB , 2) Institute of Natural Medicine ETHMEDmmm, 3) Japan Customs, 4) the Ministry of the Environment 2015, 5) JWCS 2010, "-" means no infromarion available

Results

1. Respondent attributes

798 valid responses were collected of which 44 were from people from mainland China and 176 were from Hong Kong/Macau, 533 were from Japan and 45 were from other areas. We used data only of people from Hong Kong/Macau and Japan since we did not have enough data of respondents from mainland China and other areas for analyses purposes. The mean age of respondents was 21.6 from Hong Kong/Macau and 20.4 from Japan. The ratio of male to female respondents was 38:61 from Hong Kong/Macau and 51:49 from Japan (Fig. 1).

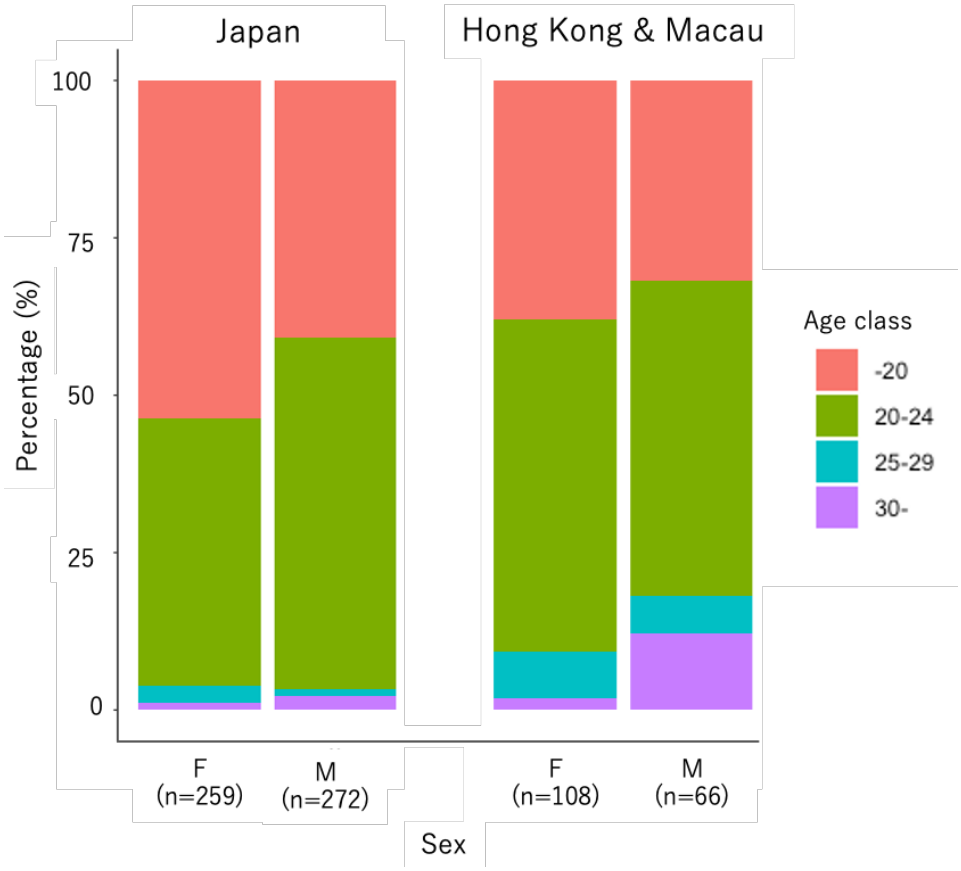

Figure1. Respondent attributes

2. Experience of using traditional medicines

Among the responses, 485 responses of "I have used traditional medicines" and 224 responses of "Never used or do not remember" in total were recorded. We found significant difference between the sexes of respondents from Hong Kong/Macau which responded to "Never used or do not remember" ($p<0.01$, $X=10.9$). In other words, there were significantly more female respondents who had not used traditional medicines than male respondents (Fig. 2).

Note: Responses for "Yes, within the past year", "Yes, before the past year" and "Yes, more than once", and "Never used" and "do not remember" were pooled due to an error of mistranslation in the questionnaire regarding the frequency of use (i.e. we divided them into user experience; whether they have used traditional medicines before, see appendix).

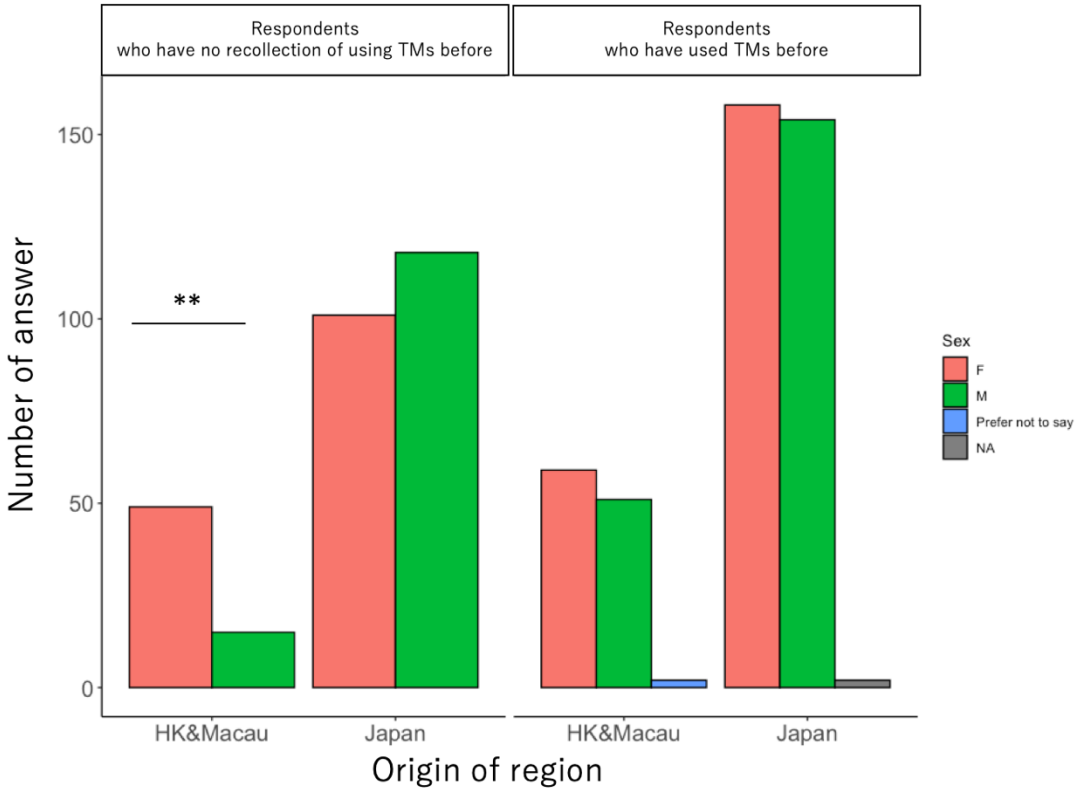

Figure 2. Experience of using traditional medicines according to sex and place of origin

3. Use of endangered species in traditional medicines

The most frequent response recorded under the question of whether respondents have ever taken traditional medicines containing ingredients from endangered species was “Unsure”. In contrast, however, responses of “Yes, I have” were rare (Fig. 3). This seems to suggest that respondents are apathetic to the presence of endangered species in traditional medicines. Surprisingly, all Japanese respondents answered that they had never taken traditional medicines containing endangered species.

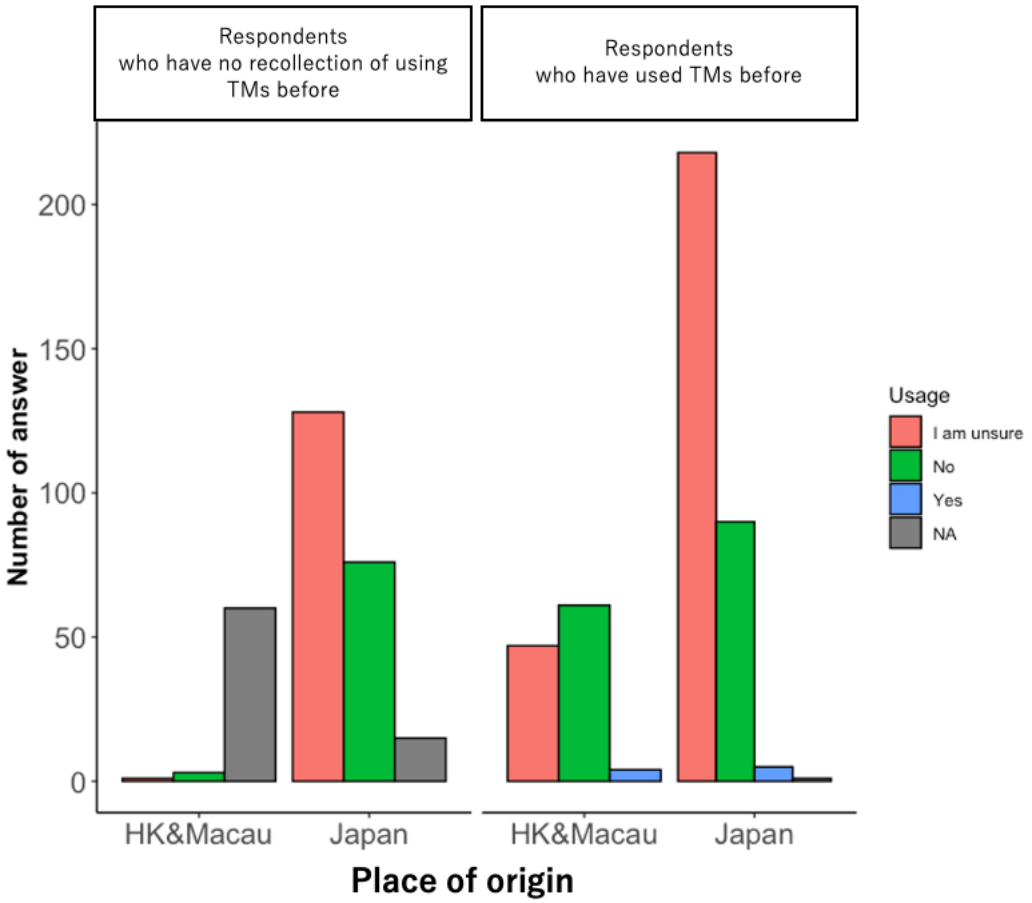

Figure 3. Experience of using traditional medicines produced from endangered species according to place of origin

4. Recognition of endangered species in traditional medicines

Upon reading through the species list, respondents were asked whether they had taken any traditional medicines containing endangered species. Among the responses, seahorse was the most often consumed, closely followed by the bear, musk deer, rhino and tokay gecko. In contrast, no one claimed they had consumed traditional medicines made from lions, leopards and totoabas (Table 2). Responses in Japan and Hong Kong/Macau also showed slight differences. For example, bear was the most consumed species for Japanese respondents whereas seahorse topped the table in Hong Kong/Macau at a remarkably higher percentage.

Table 2. Percentage of species which the respondents had taken in traditional medicines

Rank	All		Japan		Hong Kong/Macau	
	Species	%	Species	%	Species	%
1	Seahorse	4.9	Bear	4.7	Seahorse	14.8
2	Bear	4.8	Rhino	1.7	Bear	5.1
3	Musk deer	1.7	Seahorse	1.7	Musk deer	4.0
4	Rhino	1.4	Tokey gecko	1.3	Pangolin	1.7
5	Tokay gecko	1.1	Musk deer	0.9	Rhino	0.6
6	Elephant	0.6	Elephant	0.8	Japanese pond turtle	0.6
7	Japanese pond turtle	0.6	Japanese pond turtle	0.6	Tokay gecko	0.6
8	Pangolin	0.4	Tiger	0.4	Slowloris	0.6
9	Tiger	0.3	Slowloris	0.2	Saiga antelope	0.6
10	Slowloris	0.3	Saiga antelope	0.2	Tiger	0.0
11	Saiga antelope	0.3	Pangolin	0.0	Elephant	0.0
12	Totoaba	0.0	Totoaba	0.0	Totoaba	0.0
13	Leopard	0.0	Leopard	0.0	Leopard	0.0
14	Lion	0.0	Lion	0.0	Lion	0.0

Respondents were shown the same list of endangered species and were asked if they were aware of these species being used in producing traditional medicines. 162 respondents were reported not to recognize any of the species in the list. On the other hand, rhino had the most well-recognized at 36.8%, followed by the bear, seahorse and elephant. To the contrary, totoaba had the least recognition, followed by the slow loris, lion and leopard (Fig. 4). Species which were relatively well-known also corresponded to a high percentage of respondents who answered they had taken traditional medicines made from them. Compared to the respondents from Japan, respondents from Hong Kong/Macau showed a higher degree of recognition of the endangered species generally used in traditional medicines (Fig. 4).

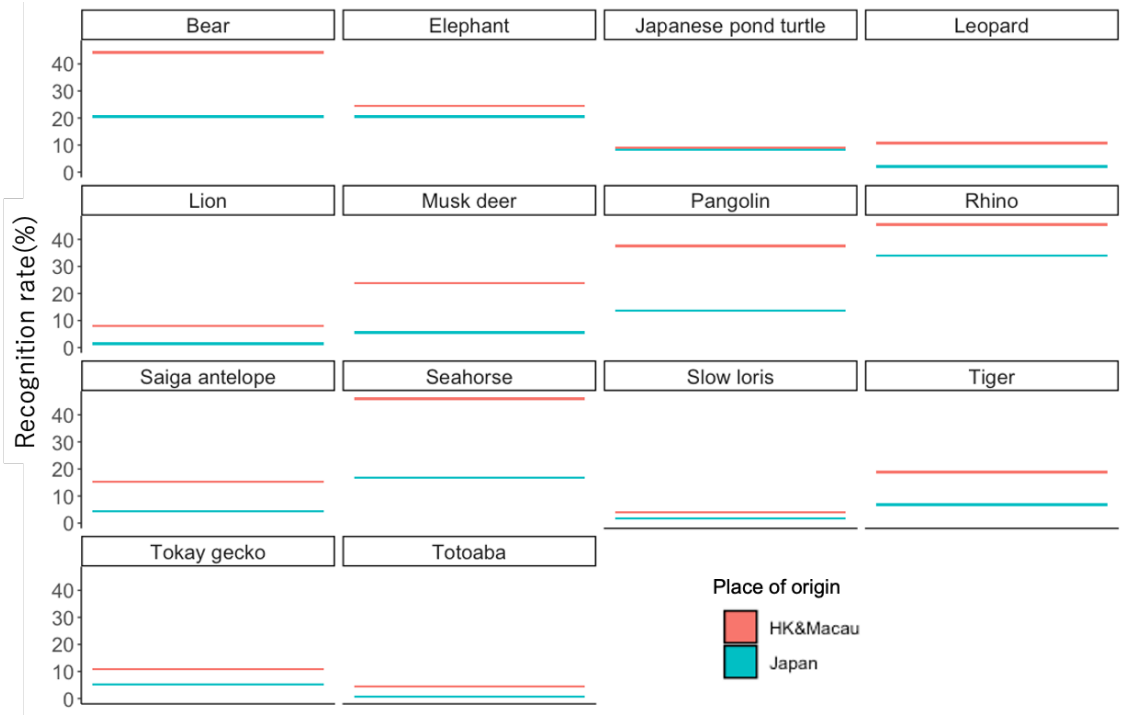

Figure 4. Percentage of respondents recognizing endangered species used in traditional medicines in Japan and Hong Kong/Macau

5. Perceived mage towards people using traditional medicines

The age group that respondents assumed would tend to use the most traditional medicines is those over 60 years old in both countries. Many respondents had the image that the elderly would use traditional medicines most often (Fig. 5).

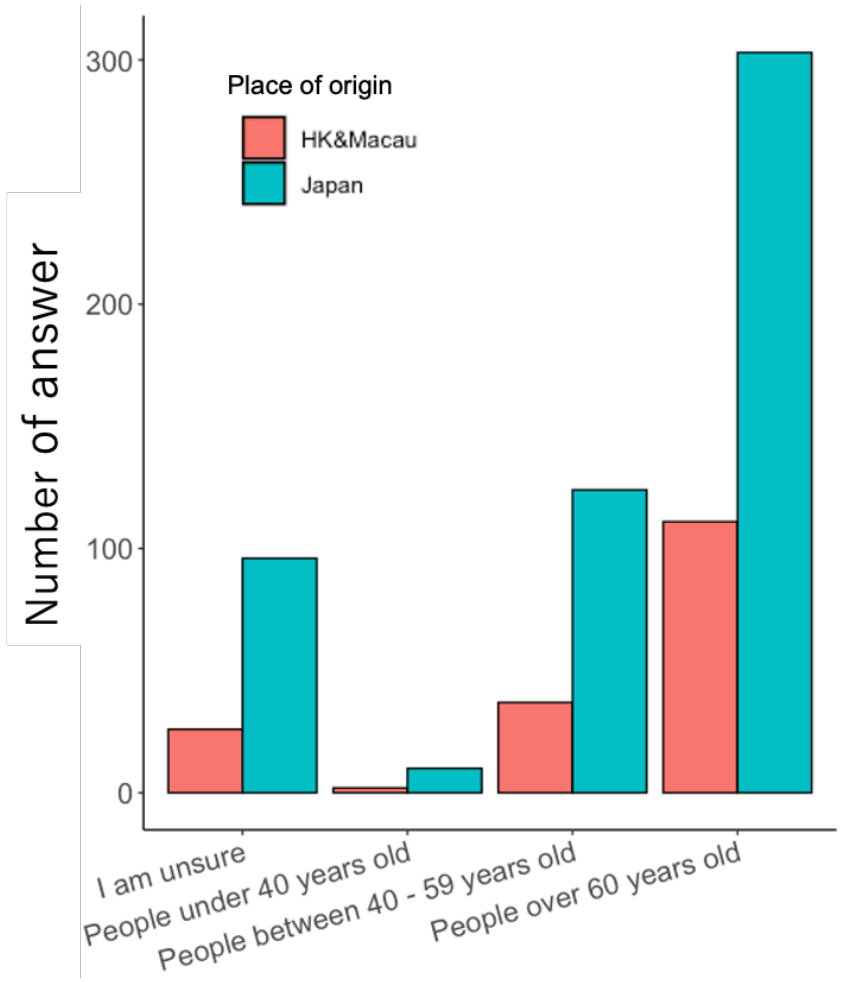

Figure 5. Image of which age group who uses the most traditional medicines

6. Attitudes towards traditional medicines

We asked three questions regarding the attitudes of respondents towards traditional medicines and the use endangered species in its production. First, we asked respondents on their attitudes towards the necessity of the medicines. Most of them disagreed to "traditional medicines are unnecessary" and no difference between the countries could be observed (Fig. 6a). However, responses show that the majority of Japanese respondents disagreed to "endangered species are vital to traditional medicines", which was not the case in Hong Kong/Macau (Fig. 6b). Finally, a large proportion of respondents answered that chemical alternatives to endangered species should be used in both regions (Fig. 6c).

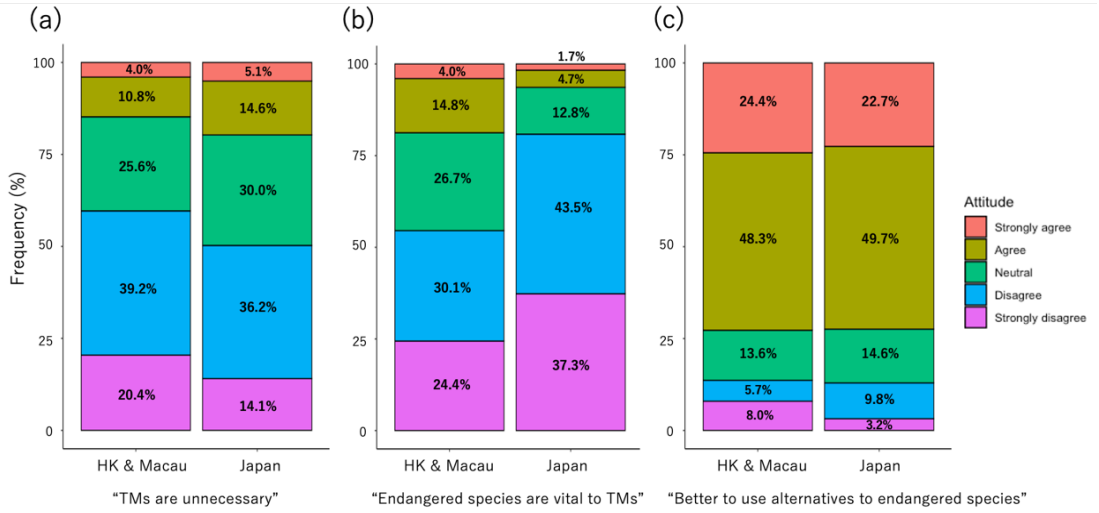

Figure 6. Attitudes towards traditional medicines by place of origin. Attitudes toward "TMs are unnecessary" (a), "Endangered species are vital to TMs" (b), "Better to use alternatives to endangered species"

We also analyzed the different attitudes among user experience because we predicted that user experience could affect the attitudes of users towards their perceived necessity of traditional medicines and their alternative options in relation to endangered species. First, a significant difference in attitude towards the necessity by user experience was observed (GLM, Disagree: $p<0.01$, Strongly disagree: $p<0.001$, Fig. 7a). Most of the respondents who had used traditional medicines agreed to the necessity of traditional medicines. However, the respondents who had never used traditional medicines were mostly neutral. Second, regarding the need for endangered species in traditional medicine there was no statistical difference observed between user experience, with much disagreement with the need for using endangered species (Fig. 7b). Lastly, "it is better to use alternatives to endangered species" was the most common

answer in which it was observed that people who had never used traditional medicines before also significantly agreed to the opinion (GLM, $p < 0.05$, Fig. 7c).

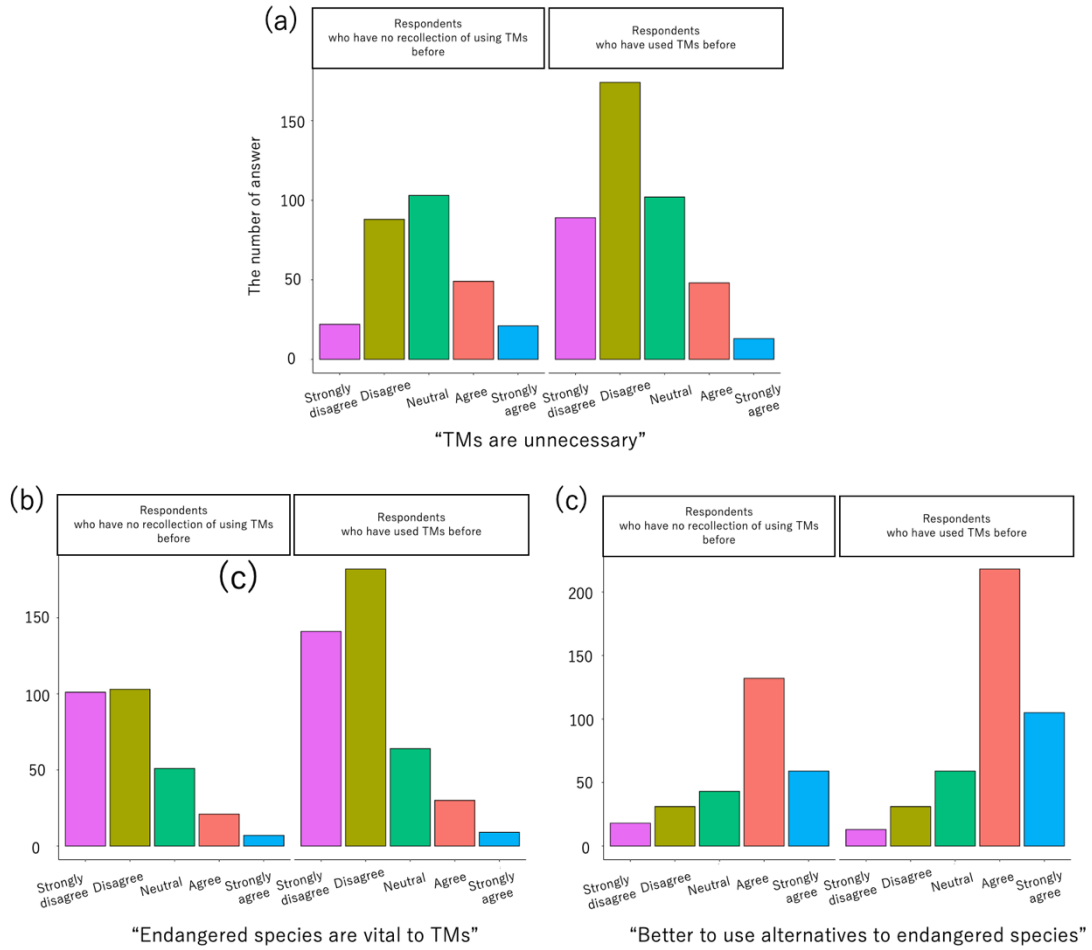

Figure 6. Attitudes towards traditional medicines by user experience. Attitudes towards "TMs are unnecessary" (a), "Endangered species are vital to TMs" (b), "It is better to use alternatives to endangered species" (c).

Discussion

The majority of respondents had used traditional medicines before and expressed their belief that traditional medicines are necessary. Although the student respondents held the image that the elderly uses the most traditional medicines, traditional medicines are also widely used by young people in both regions.

Many respondents were uncertain about the presence/absence of endangered species in traditional medicines and 23% of them answered that they did not know all 14 species in the endangered species list used in the production of traditional medicines. It is considered that they lack an awareness about endangered species being used as an ingredient in making certain traditional medicines. A difference of awareness was observed between respondents of different regions regarding the use of endangered species in traditional medicines. Respondents from Hong Kong/Macau were more aware of the endangered species used in traditional medicines than those from Japan. There was no significant difference in the user experience between respondents of the different regions, suggesting that there was no correlation between the awareness of the species and where respondents originated. Furthermore, although many respondents in both regions agreed to the use of alternatives, the respondents in Hong Kong/Macau were more in favor of the use of endangered species in traditional medicines than those in Japan. Given that it is possible that the high awareness of endangered species in the medicines does not necessarily lead to a behavioral restraint of purchasing traditional medicines containing endangered species. In terms of the conservation of endangered species, it is necessary to raise awareness among the population of the use of endangered species as ingredients of traditional medicines in a country like Japan, where there is little interest in the ingredients of traditional medicines and where many respondents said that there is no need for conserving endangered species. In addition to the improvement of the awareness, since the majority of the opinions in both countries were in favor of the use of alternatives, it is recommended to actively promote the use of alternatives.

The species that respondents most often used in traditional medicines was roughly correlated to the species that was most highly recognized as being used in traditional medicines. For example, bears, rhinos and seahorses ranked high in both. As an exception, however, although recognition of traditional elephants as an endangered species was high even though its rate of use in traditional medicines is relatively low. Since elephants have often been reported in the media for illegal ivory trade, it is considered that elephants were highly recognized not only for their value in producing traditional medicines, but also for illegal trade. Therefore, mass media can be effective

in raising awareness of wildlife concerns.

In conclusion, it is expected that the consumption of endangered species in traditional medicines will be reduced by raising awareness of the species through the media and by further developing and promoting the use of alternatives.

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Appendix. Evaluating the Public Knowledge on the Use of Endangered Species in Producing TM Questionnaire in English

1. Place of origin, age, sex

2. Have you ever taken traditional medicines?
   A: Yes, within the past year; Yes, before last year; Never; I do not remember

3. Did the traditional medicines you consumed include medicines made from endangered species?
   A: Yes; No; I am unsure

4. Which age group you think use traditional medicines made out of endangered species the most?
   A: people under 40 years old; people between 40- 59 years old; people over 60 years old; I am unsure

5. Which of the following species were present in traditional species that you/your family members have used?
   A (multiple choices allowed): Bear; rhinoceros; pangolin; Japanese pond turtle; tiger; elephant; tokay gecko; lion; slow loris; leopard; totoaba; musk deer; saiga antelope; seahorse

6. Which of the following species are you aware of – with regard to usage in manufacturing traditional medicines?
   A (multiple choices allowed): Bear; rhinoceros; pangolin; Japanese pond turtle; tiger; elephant; tokay gecko; lion; slow loris; leopard; totoaba; musk deer; saiga antelope; seahorse

7. Endangered species are vital to the making of traditional medicines.
   A: Strongly agree; agree; neutral; disagree; strongly disagree

8. It is better to use other chemical synthesis or poultry which have the same composition as endangered species to make traditional medicines.
   A: Strongly agree; agree; neutral; disagree; strongly disagree

9. Traditional medicines are unnecessary.
   A: Strongly agree; agree; neutral; disagree; strongly disagree