

A preliminary understanding of saiga horn consumption in Singapore

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Abstract

The Critically Endangered saiga antelope *Saiga tatarica* faces an uncertain future, with populations dwindling from recent epidemics in its range countries, and continuous pressure from the demand for its horns in the Traditional Chinese Medicine (TCM) trade. Singapore is a major hub for the global saiga horn trade and an important consumer country, with saiga horn products widely available in the domestic market. Despite this, little is known about the consumers that drive domestic demand. Before interventions are carried out, it is important to understand who consumers are, and what their motivations are. We conducted a preliminary investigation into consumption prevalence, consumer demographics, knowledge and motivations. We sampled 230 Chinese Singaporeans, through a combination of face-to-face interviews and self-administered questionnaires. Recent consumption incidence (in the past 12 months) was relatively high at 13%. Younger respondents (18 to 35 years) had the highest recent consumption prevalence (25%), often due to influence from an older family member or friend. Bottled saiga horn ‘cooling’ water was the most popular among recent users (50%), followed by horn shavings (31%) and tablets (13%). Awareness of conservation issues and regulations was uniformly low. Awareness raising may have an effect in reducing consumer

26 demand in Singapore. However, due to the preliminary nature of this study, it is best used to
27 guide and inform future research underlying behavioural change interventions into a
28 relatively understudied but important consumer group, Chinese Singaporeans. (232 words)

Introduction

The demand for animal products for medicinal purposes is one of the major drivers of the illegal wildlife trade globally, across a range of taxa (Warchol, 2007; Nijman, 2010). Over the last few decades, this demand has led to the unsustainable killing of wildlife, causing rapid declines in the affected populations (Mittermeier *et al.*, 1999; Zhang *et al.*, 2008; Bennett, 2015; Ferreira *et al.*, 2015). Understanding consumer behaviour and motivations is a vital component in tackling this threat, as it provides a foundation for the development of effective long-term campaigns that reduce wildlife consumption (Wasser & Jiao, 2010; Burgess, 2016).

Singapore has a history of wildlife consumption for medicinal use (Martin, 1983; Barnard, 2014). Although investigations into wildlife products for sale in the traditional Chinese medicine market have been conducted (Govind & Ho, 2001; Ng & Burgess, 2004; Meibom *et al.*, 2010), little work has been done to understand the local consumers that drive the trade.

Traditional Chinese medicine (TCM) is regarded as a part of Singapore's heritage and Chinese culture (Ministry of Health, 1995), and as a form of Complementary and Alternative Medicine (CAM) complementary to the Western-based healthcare system in Singapore.

Chinese medicine shops located within housing estates, and modernized franchises found in many shopping malls, provide over-the-counter TCM products throughout the country. The number of TCM products from endangered animals available in Singapore appears to have decreased in the past few decades due to reduced domestic demand, trade bans for CITES Appendix I species, higher penalties and increased enforcement (e.g. rhino and bear, Martin, 1983; Foley *et al.*, 2011; AVA & Singapore Customs, 2017; Theng & Krishnasamy, *In Press*). One of the few that remains widely available is saiga horn (Theng & Krishnasamy, *In*

Press), locally known as *Ling Yang Jiao*, believed to be effective in reducing fevers, detoxification, assuaging epilepsy, and also good for the liver (Zang, 1990).

The horn used in *Ling Yang Jiao* comes from the saiga antelope *Saiga tatarica*, which is a nomadic herding species of the steppes and semi-desert regions of southeastern Europe and Central Asia. Two subspecies occur: *S. t. tatarica*, found in Kalmykia, Russian Federation (one population), and in Kazakhstan (three populations: Ural, Ustiurt, Betpak-Dala), and *S. t. mongolica*, found in Mongolia. Once abundant (Sokolov & Zhirnov 1998), population numbers have undergone massive reductions from >1,000,000 in the 1980s to an estimated low of 178,000 in 2000, largely as a result of uncontrolled hunting for meat and horns (Milner-Gulland *et al.*, 2001; CMS, 2015). Horns are a key target for poachers as they are highly prized in TCM, and used in several Asian countries such as Singapore (Chan, 1995). This has led to males being intensively hunted, resulting in heavily skewed sex ratios and reproductive collapse (Milner-Gulland *et al.*, 2003). Following conservation action, the species started to recover, but a recent catastrophic mass die-off from bacterial infection of >200,000 individuals (more than 60% of the global population) in Kazakhstan in May 2015 and an ongoing epidemic in Mongolia (which may kill up to 80% of the *S.t. mongolica* population) have undermined this recovery, putting the Betpak-Dala and Mongolian populations in a critical situation (Bonn, 2016, SCA, 2017). Together, the disease outbreaks and the continued poaching, especially of males for their horns for use in the TCM trade, has resulted in saiga antelopes facing an uncertain future (SCA, 2016).

In an effort to protect the species, it was listed on CITES Appendix II in 1995. It was recognised as Critically Endangered in the IUCN Red List of Threatened Species in 2002 (Mallon, 2008). All Saiga range countries have implemented moratoria on hunting and

trade

of the species at different

currently no legal horn export is permitted from range countries until the conservation status of Saiga improves (CMS, 2017). International legal trade in saiga horn remained high in 1995–2004, at 87,449 kg, with the largest importers being China (34,851 kg), Singapore (17,186 kg) and Japan (13,312 kg; Meibom *et al.*, 2010). Singapore played an important role as the main hub of Saiga horn trade in Southeast Asia, importing the majority of its saiga horns from the Russian Federation and Hong Kong and re-exporting mainly to China, Malaysia and Hong Kong (Meibom *et al.*, 2010). A study in 2016, focused on Singapore's recent international and domestic saiga horn trade, showed that while legal import of horns had declined by 99% over the last decade, Singapore's stockpile of horns continues to fuel high export quantities to Hong Kong, China and Malaysia, and to supply the domestic trade in saiga products (Theng & Krishnasamy, *In Press*). Because of the domestic stockpile, consumption of saiga products is legal in Singapore, and products are openly displayed and bought. 97% of the 188 Chinese medical halls surveyed sold some form of saiga horn (whole, shavings, cooling water, tablets, tea; Theng & Krishnasamy, *In Press*), which was often prominently displayed and spoken about openly by vendors. The continued high availability of the product in shops suggests that there continues to be a demand, prompting the need to gain an understanding of saiga horn consumption among the Singapore populace.

Here we attempt to gain an initial understanding of consumer insights and awareness levels by surveying Chinese Singaporeans to address the following objectives: (1) gauge the prevalence of consumption of saiga horn products, (2) identify the demographics of saiga horn product users, non-users and lapsed users, (3) identify the consumption and purchase behaviours relating to saiga horn products, (4) identify the motivations and barriers to consuming the products, and (5) gauge understanding of saiga status and harvest.

104

105 **Methods**

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107 *Pre-survey*

108 A questionnaire was formulated in English and Mandarin (refer to Appendix). Although
109 Chinese medical hall vendors mentioned non-local purchasers of saiga horn in an earlier
110 market survey, specifically mainland Chinese tourists (Theng & Krishnasamy, *In Press*), only
111 local Chinese Singaporeans were surveyed. Non-Chinese were excluded from the study in
112 order to focus the scope to the core TCM user demographic.

113

114 The questionnaire consisted of three parts. The first comprised questions about the
115 respondent's socio-demographic attributes, including TCM consumption and purchase. The
116 respondents were then streamed into either 'users' (consumed saiga horn product in the last
117 12 months) or 'non-/lapsed users' (not consumed saiga horn product in the last 12 months).
118 'Users' completed Section A, comprising questions about respondents' saiga horn product
119 consumption behaviour, trends between past and present use, and motivations for
120 consumption. 'Non-' and 'lapsed-users' completed Section B, containing questions about
121 past use (more than 12 months ago) and motivations for non-recent or non-consumption of
122 saiga horn products. Both sections also asked about the use of alternatives to saiga horn
123 (synthetic, animal- or plant-based products) and the reasons for their use instead of saiga horn
124 products. The questionnaire was refined and corrected after a pilot survey with 19
125 respondents in the Choa Chu Kang neighbourhood.

126

127 Based on several Chinese medical hall vendors in an earlier market survey identifying elderly
128 Chinese Singaporeans as their main local clientele for saiga horn products (Theng &

Krishnasamy, *In Press*), we biased our sampling towards elderly (> 60 years) people (making up 50% of our sample), with the middle-aged (36–59 years) and young (18–35 years) demographics each targeted to make up 25% of respondents.

Survey administration

The questionnaires were administered through either a face-to-face interview or a self-administered questionnaire by MT and an assistant (both Chinese Singaporeans) to 230 Singaporean respondents. From October to November 2016, survey sessions were conducted between 08.30 and 15.00 in nine public housing-dominated neighbourhoods (Bishan, Bukit Merah, Chinatown, Jurong East, Jurong West, Serangoon, Tampines, Woodlands, Yishun; see Appendix). The locations and times were selected based on the likelihood of people from a variety of socioeconomic backgrounds being available. Due to constraints of time and cost, potential respondents were targeted by perceiving their likely willingness to complete a questionnaire (e.g. person waiting for a friend rather than one rushing to work). Respondents were instructed to complete the questionnaire in their preferred language (English or Mandarin), with interviewers present to clarify questions when required. Some respondents requested that questions be read aloud in an interview format. To minimise self-selection bias, potential respondents were asked if they were willing to participate in a general TCM-related survey without describing the topic or intent. Because we aimed to protect respondents' anonymity and minimise survey sensitivity, no personal data that could be used to identify individuals were collected.

We conducted the face-to-face approach because it garners better response rates than online, mail or telephone surveys and is usually more representative of the population compared to online surveys (Groves *et al.*, 2009; Szolnoki, 2013). Because this study was only conducted

in public-housing dominated neighbourhoods, our responses may be limited to low- to middle-class citizens. Furthermore, due to the small sample size and the possibility of confusion with other horn products (particularly when purchased as shavings), any trends should not be taken to be a conclusive representation of the volume of trade in saiga horn. As the first of its kind, this study aimed to obtain a rapid and preliminary understanding of saiga horn consumption levels and behaviour, and awareness levels in Singapore, that could inform future efforts to tackle this conservation issue.

Data analyses

Responses were accepted for analysis if the first section on demographics was completed. Statistical analysis of the survey data was performed using the R software program (R Core Team, 2016). Chi-square tests were used to determine whether there was a significant difference between expected and observed frequencies of consumption behavior between the different groups.

Results

We obtained responses from 230 Chinese Singaporeans (elderly: 109; middle-aged: 66; young: 55. Female: 118; male: 112). Overall, 13% had consumed saiga horn products recently (in the last 12 months), with an additional 40% having consumed the product more than 12 months ago (lapsed users). Our data shows a relationship between age class and saiga horn use ($\chi^2=7.814$, $n=230$, $df = 2$, $p=0.020$), reflecting a higher prevalence of recent consumption among the younger demographic (18–35 years; 25% prevalence) as compared to the middle-aged (36–59 years; 17% prevalence) and elderly demographic (>60 years; 9% prevalence).

General TCM consumption and purchase behaviours differed between the ‘users’ and ‘lapsed/non-users’. Recent saiga horn product users were more likely to have recently consumed and purchased other TCM products as compared to saiga horn product lapsed/non-users (consumption: 97% vs 71%, $\chi^2=9.304$, $n=230$, $p=0.001$; purchase: 88.6% vs 65.1% $\chi^2=6.533$, $n=230$, $p=0.005$). There were no significant differences in gender, education level and income level between ‘users’ and ‘lapsed/non-users’.

Users

The most commonly used saiga horn product was bottled “fresh” saiga water (49%), followed by shavings (40%), bottled “supermarket” saiga water (20%) and tablets (17%; Fig. 1). Only one user had used a whole horn, which needs to be shaved down and boiled before being consumed. In shops, horn shavings are usually sold in small amounts by weight or ready-packaged with herbs. “Fresh” saiga water is made out of horn shavings that have been boiled with water and packaged into bottles for sale in TCM shops for immediate consumption. This is different from “supermarket” saiga water that is a widely available brand of cooling water that does not contain animal products, that some consumers often mistake for containing *Ling Yang*. The tablets usually contain saiga horn in trace amounts of less than 1 per cent, sold as remedies for cold and fever.

For most ‘users’ overall consumption had not changed in the past 2–3 years (69%). Saiga horn products were obtained from a variety of sources: franchise/chain stores (34%), privately owned stores (34%), family/friends (23%) and others (9%). Among the users’ motivations for their last consumption of saiga horn, more young people than middle-aged or older indicated having had an ‘elder/family buy it for them’ and ‘a family member or friend’s

recommendation' (Fig. 2). Higher numbers of middle-aged and old people decided their last consumption for themselves. However, the differences were not statistically significant.

Price changes (by $\pm 20\%$) and not knowing anyone else who uses saiga horn products did not appear to be considerations in consumption decisions among most users (Fig. 3). Factors that most respondents said would make them stop consuming saiga horn entirely were if these products were banned, if they learnt it threatens the survival of saiga in the wild or that harvest was cruel.

Lapsed/non-users

Among the 195 respondents who had not consumed saiga horn in the past 12 months, 47% had consumed it before (i.e. 'lapsed user') and 51% had never consumed it (i.e. 'non-user'). Slightly more than half of the lapsed users had not consumed saiga horn in more than 10 years (53%), while 27% had consumed it within the past 2-3 years and 20% in the last 4-10 years. No significant differences were found between the reasons given by lapsed and non-users for stopping/not consuming saiga horn, except that no non-users selected 'elder/family stopped buying for me' more often (Fig. 4). The most popular reason given by lapsed and non-users for stopping/not consuming saiga horn was not having a use or need for it (45% and 48% respectively). Among the 21 respondents who stated that people had stopped buying horn for them, there were significantly fewer old respondents than young and middle aged respondents ($\chi^2=12.79$, $p=0.002$).

Reasons for using saiga horn or alternatives

The main reason for consuming saiga horn was significantly different among the 'users', 'lapsed users' and 'non-users' ($\chi^2=65.67$, $n=225$, $p=3.563e^{-11}$; Fig. 5). Saiga horn is still

widely believed among users and lapsed users to be effective for its cooling effects by clearing 'heatiness' and releasing toxins to cure related ailments such as fevers and sore throats, (users: 77%, lapsed users: 86%). Among those who have not consumed saiga horn, 37% thought clearing 'heatiness' was the main reason others consumed it, while most indicated that they did not know/did not want to answer (46%).

There was no significant difference between the groups in their use of alternatives ($\chi^2=16.71$, $n=220$, $p=0.081$; Fig. 6). Synthetic alternatives such as paracetamol appeared to be the most popular alternative to saiga horn used in the last 12 months (40% users, 45% lapsed/non-users). This is followed by plant-based alternatives such as herbal tea (users: 42%, lapsed/non-users: 31%) and none of the stated alternatives (users: 26%, lapsed/non-users: 24%). None of the saiga horn users indicated use of an animal-based alternative (e.g. horns from other species) and only three lapsed/non-user respondents indicated their recent use of such an alternative. Among the reasons given for the use of alternatives instead of saiga horn, the most cited among the users was that it was more available than saiga horn (29%). In the lapsed and non-user group the main reason was that they had not considered using saiga horn (40%).

Awareness

Awareness about the regulations surrounding saiga horn use, the species' status and harvest methods was consistently low across all user groups and ages. Only 13% ($n=29$) of respondents were aware that there were regulations on saiga horn trade (users: 3%, lapsed: 20%, non-users: 9%). Of these, only two answered correctly; that only licensed products can be sold. 68% did not know, while the remaining 29% answered wrongly. Similarly, few were aware of the status of the saiga in the wild, with 79% of all respondents saying they did not

know and just 4% giving the correct answer (that saiga is found in several countries and some populations are declining). A higher proportion was aware that saiga are killed in the wild for their horns and meat, however awareness that this is the case was still low (13%), while the majority did not know or did not want to comment about the harvest method (72%). When asked if they thought saiga horns could grow back after being cut off, a third of lapsed and non-users answered 'no' correctly (34%), while a higher proportion (49%) of users did so.

Discussion

The main aim of this study was to gain a preliminary insight into the prevalence of saiga horn consumption among the Singaporean Chinese population, which groups were consuming them and the motivations for doing so. On a broader level, we wanted to understand general consumption and purchase behaviours, and the level of knowledge about the status and conservation of the saiga. This is the first study into the consumers of a wildlife product in Singapore and provides baseline information upon which further behavioural intervention studies can be founded.

Consumption prevalence and motivations

As expected from the high availability of saiga products in the Singapore market (Theng & Krishnasamy, *In Press*), there appears to be a relatively high continued use of saiga horn products in Singapore. Moreover, this does not appear to be a trade that is in decline. Contrary to our assumption that the main local consumers of saiga horn were elderly, based on prior remarks made by Chinese medical hall vendors that their local customers tended to be elderly (Theng & Krishnasamy, *In Press*), recent consumption prevalence turned out to be the lowest in that age group, followed by the middle-aged (36–59 years), and was surprisingly highest among the young respondents (18–35 years; 25%). This significant

difference in use could be attributed to the general belief that saiga horn is more effective in treating the young and that the “cooling” effects of the product may conversely be detrimental to the health of the elderly, a point made by several elderly respondents during the survey. These products may thus often be purchased by the elderly but for the consumption of their younger kin. The motivations behind the consumption by young respondents suggest this, as a higher number compared to both the older age groups indicated that an elder/family members purchased it for them or that a family/friend recommended it, as reasons for their last consumption. This finding suggests that there may be some intergenerational effect and influence on the consumption of saiga horns, the strength of which should be further examined and could be leveraged in future behavioural change campaigns. A similar study into the consumption of TCM animal products in Beijing found the reverse, that older people were more likely to consume animal-based TCM products compared to the younger; however, this did not differentiate between products depending on their specific target demographic (Liu *et al.*, 2016). Several studies on the level of general TCM use in Taiwan and one in Australia appeared to find a similar trend that TCM use peaked in younger adults (individuals around 30 years old) and was lowest among older adults (51–62 years old), although it is not known why (Sherwood, 2000; Chen *et al.*, 2007; Daly *et al.*, 2009; Shih *et al.*, 2012). The same Taiwanese studies found that females were more likely than males to engage in TCM use, a finding not reflected in this study. Recent saiga horn users in our study were more likely than lapsed/non-users to have recently consumed and purchased other TCM products.

Our study suggests that consumption behaviour is not particularly price sensitive. Previous studies have demonstrated a similar phenomenon, that TCM consumers are willing to pay high prices for wild-sourced animal products because they believe that these products are

302 more potent (Gratwicke *et al.*, 2008; Dutton *et al.*, 2011). Saiga horn products are relatively
303 expensive compared to the products they are grouped with in TCM shops; for example, of the
304 range of cooling waters routinely on sale, the majority cost around SGD\$2, compared to
305 SGD\$5 for saiga water (pers. obs.). This may be because saiga water is generally considered
306 to be particularly strong and effective as an anti-heatiness product (pers. obs.).

307

308 Awareness about regulations, status and harvest methods surrounding the saiga was low.
309 Most respondents knew “Ling Yang” as a TCM product and understood its effects, but did
310 not know much more than that. Although this animal product is widely available and well-
311 known among the local Chinese community in Singapore, there is a need to explain the
312 harvesting methods used and status of the species, which may have an impact on consumer
313 behaviour. The most influential factors that respondents said would stop their consumption of
314 saiga horn appear to be if the product was banned, if the practice caused the saiga to be
315 endangered or if harvest practices were cruel (Fig. 2), reflecting a potential for raising
316 conservation awareness to reduce demand. Conservation awareness has been previously
317 argued to have an important impact on consumer behaviour in the wildlife trade context
318 (Nowell & Xu, 2007; Wasser & Jiao, 2010). This has been loosely proven to be effective in
319 the decreasing demand for sharks’ fin in Singapore (WWF Singapore, 2016) and could
320 potentially be emulated for saiga horn. A study in Beijing found that as conservation
321 awareness among survey respondents increased, they were more likely to choose substitutes
322 and less likely to choose wild-sourced animal-based TCM products (Liu *et al.*, 2016). It
323 appears that many respondents in this study already use what would be considered
324 alternatives or weaker alternatives to saiga horn, generally to ‘cool’ the body and clear
325 ‘heatiness’ and to cure related ailments such as fever. The use of other animal horns (i.e.
326 water buffalo, sheep and mountain goat) as substitutes does not appear to be popular,

possibly because they are seen as too weak to cure ‘heatier’ ailments like persistent fevers (according to vendors) or are usually sold in shavings form rather than the more popular ‘cooling waters’ (Theng & Krishnasamy, *In Press*). The synthetic alternative (Western medicine, e.g. paracetamol) was popular mostly because it was more widely available; although a quarter of saiga horn users said they did not use a substitute.

Hence, promoting the use of synthetic alternatives for fevers, which are cheaper, more available and proven effective, and herbal tea as a preventive measure when one feels the need to ‘cool’ the body, could be an idea to explore in future studies. However, these observations and suggestions are far from representative or conclusive due to the preliminary nature of this study. A deeper understanding of the thought process that goes into deciding between the use of an alternative and saiga horn to treat an ailment is needed, for conservation awareness alone may not truly drive behavioural change and subsequent demand reduction (Lertzman & Baragona, 2016). Uncovering the attitudes saiga horn users generally have toward TCM versus Western medicine is important. For example, in Hong Kong, some TCM consumers feel that Western medicine is sometimes too powerful with significant side effects and prefer TCM because it is believed to cure the root of the problem (Lam, 2001).

Future research perspectives

This study was the first in Singapore to examine consumer relationships with a major TCM product derived from a critically endangered species. Although suggestive findings emerged, the study was preliminary in nature. Sampling was opportunistic and focussed towards older consumers, and the sample size was small. Despite the relatively high prevalence of saiga horn use, the actual number of recent users was small, thus any trends derived should not be

taken to be a conclusive representation of the population. Future surveys could be randomized to improve representativeness. It will also be important to see whether saiga horn consumption is in any way sensitive, potentially necessitating an indirect questioning method (Nuno & St John, 2015), and to investigate its price sensitivity.

This research is being used to guide and inform future more detailed research underlying behavioural change interventions. This includes understanding the motivations and demographics of TCM users in order to design and implement effective behavioural change campaigns. Too often campaigns are implemented without a solid foundation in behavioural science (Olmedo *et al.*, 2017). This preliminary survey lays the foundation for a more detailed understanding of the identity and attitudes of the consumers of a particularly important TCM product, saiga horn, in a relatively understudied but important consumer group, Chinese Singaporeans. We showed that saiga horn use is relatively prevalent, that awareness of the conservation issues and relevant legislation is very low, and that younger people particularly are using saiga products, especially cooling water, to treat "heatiness". These results suggest that an awareness-raising campaign that focuses on this demographic group and product type might be a useful approach to reducing consumption of saiga horn; such a campaign is now under development. It is also vital for the prevalence, characteristics, and motivations for saiga product use to be investigated in other countries and online, to tackle the dearth of information about the trade in this Critically Endangered species.

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Author contributions

MT, JAG and EJMG designed the questionnaire and survey methods; MT conducted the survey; MT led the writing with the main support of EJMG

References

- Barnard, T. P. (2014) *Nature Contained: Environmental Histories of Singapore*. NUS Press, Singapore.
- Bekenov, A.B., Grachevand, I. A. & Milner-Gulland, E.J. (1998) The ecology and management of the Saiga Antelope in Kazakhstan. *Mammal Review*, 28, 1–52.
- Bennett, E. (2015) Legal ivory trade in a corrupt world and its impact on African elephant populations. *Conservation Biology*, 29(1), 54–60.
- Bonn (2016) Signs of hope for Saiga Antelope after mass die-off in 2015. Saiga Antelope: Memorandum of Understanding concerning Conservation, Restoration and Sustainable Use of the Saiga Antelope. 15 June 2016. <http://www.cms.int/saiga/en/news/signs-hope-saiga-antelope-after-mass-die-2015>. Accessed on 13 September 2016.
- Burgess, G. (2016) Powers of persuasion? Conservation Communications, Behavioural Change and Reducing Demand for Illegal Wildlife Products. *TRAFFIC Bulletin*, 28(2), 65–73.

400 Chan, S. (1995) A survey of markets for Saiga horns in East and Southeast Asia. In: Chan, S.
 401 Maksimuk, A.V., Zhirnov, L.V. and Nash, S.V. (Eds), *From Steppe To Store: The Trade*
 402 *In Saiga Antelope Horn*. TRAFFIC International, Cambridge.

403 Chen, F. P., Chen, T. J., Kung, Y. Y., Chen, Y. C. Chou, L. F., Chen, F. J. & Hwang, S. J.
 404 (2007) Use frequency of traditional Chinese medicine in Taiwan. *BMC Health Services*
 405 *Research*, 7, 26.

406 CMS (2015) *Third Meeting of the Signatories to the Memorandum of Understanding*
 407 *Concerning Conservation, Restoration and Sustainable Use of the Saiga Antelope*
 408 *Tashkent, Uzbekistan, 26-29 October 2015*. Convention on Migratory Species.

409 CMS (2017) National Reports. CMS Saiga
 410 MOU. <http://www.cms.int/saiga/en/documents/national-reports/>. Accessed on 1 October
 411 2017.

412 Daly, M., Tai, C. J., Deng, C. Y. & Chien, L. Y. (2009) Factors associated with utilization of
 413 traditional Chinese medicine by white collar foreign workers living in Taiwan. *BMC*
 414 *Health Services Research*, 9, 10.

415 Dutton, A. J., Hepburn, C. & Macdonald, D. W. (2011) A stated preference investigation into
 416 the Chinese demand for farmed vs. wild bear bile. *PLoS One*, 6, e21243.

417 Foley, K. E., Stengel, C. J. & Shepherd, C.R. (2011) *Pills, Powders, Vials and Flakes: the*
 418 *bear bile trade in Asia*. TRAFFIC Southeast Asia, Petaling Jaya, Selangor, Malaysia.

419 Gavin, M. C., Solomon, J. N. & Blank, S. G. (2010) Measuring and monitoring illegal use of
 420 natural resources. *Conservation Biology*, 24(1), 89–100.

421 Govind, V. & Ho, S. (2001) *The trade in bear gall bladder and bear bile products in*
 422 *Singapore*. Animal Concerns Research and Education Society (ACRES).

423 Gratwicke, B., Bennett, E., Broad, S., Christie, S., Dutton, A. & Gabriel, G. (2008a) The
 424 world cannot have wild tigers and eat them, too. *Conservation Biology*, 22, 222–223.

425 Groves R. M., Fowler Jr., F., J., Couper, M. P., Lepkowski, J. M., Singer, E. & Tourangeau,
 426 R. (2009) *Survey Methodology*, 2nd Edition. John Wiley & Sons, Hoboken.

427 Lam, T. P. (2001) Strengths and weaknesses of traditional Chinese medicine and Western
 428 medicine in the eyes of some Hong Kong Chinese. *Journal of Epidemiology & Community*
 429 *Health*, 55, 762–765.

430 Lertzman, R. & Baragona, K. (2016) Reducing desire for ivory: a psychosocial guide to
 431 address ivory consumption. WWF. [http://www.changewildlifeconsumers.org/wp-](http://www.changewildlifeconsumers.org/wp-content/uploads/2016/02/ReducingDesireforIvory_011917_print-1.pdf)
 432 [content/uploads/2016/02/ReducingDesireforIvory_011917_print-1.pdf](http://www.changewildlifeconsumers.org/wp-content/uploads/2016/02/ReducingDesireforIvory_011917_print-1.pdf). Accessed on 26
 433 March 2017.

434 Liu, Z., Jiang, Z., Fang, H., Li, C., Mi, A., Chen, J., *et al.* (2016) Perception, price and
 435 preference: consumption and protection of wild animals used in traditional medicine.
 436 *PLoS ONE*, 11(3), e0145901.

437 Lushchekina A., Struchkov A. (2001) The saiga antelope in Europe: once again on the brink?
 438 *The Open Country*, 3, 11–24.

439 Martin, E.B. (1983) The decline in the trade of rhinoceros horn. *Swara*, 6(5), 10–15.

440 Milner-Gulland, E.J., Bukreeva, O.M., Coulson, T., Lushchekina, A.A., Kholodova, M.V.,
 441 Bekenov, A.B. & Grachev, I.A. (2003) Conservation: Reproductive collapse in saiga
 442 antelope harems. *Nature*, 422, 135.

443 Meibom, S. v., Vaisman, A., Neo, L., Song, H., Ng, J. & Xu, H. (2010) *Saiga Antelope trade:*
 444 *global trends with a focus on South-East Asia*. TRAFFIC Europe and CITES.

445 Ministry of Health (1995). Practice of consultation of TCM Practitioners by the Singapore
 446 Population, 1994. Annex 4 Page 1 of A Report by the Committee on TCM Oct 1995.

447 Ng, D. & Burgess, E. A. (2004) *Against the grain: Trade in Musk Deer Products in*
 448 *Singapore and Malaysia*. TRAFFIC Southeast Asia, Petaling Jaya, Selangor, Malaysia.

449 Nuno, A. & St John, F. A. V. (2015) How to ask sensitive questions in conservation: A
 450 review of specialized questioning techniques. *Biological Conservation*, 189, 5–15.
 451 Olmedo, A., Sharif, V. & Milner-Gulland, E.J. (2017) Evaluating the design of behaviour
 452 change interventions: a case study of rhino horn in Vietnam. *Conservation Letters*,
 453 doi:10.1111/conl.12365.
 454 R Core Team (2016) R: A language and environment for statistical computing. R Foundation
 455 for Statistical Computing, Vienna, Austria. URL <https://www.R-project.org/>.
 456 SCA (2016) Saiga News. Saiga Conservation Alliance. Winter 2015/Spring 2016: Issue
 457 20. <http://www.saiga->
 458 [aconservation.com/saiga_news.html?file=tl_files/pdf/SaigaNews/English+issue_20.pdf](http://www.saiga-conservation.com/saiga_news.html?file=tl_files/pdf/SaigaNews/English+issue_20.pdf).
 459 Accessed on 13 December 2016.
 460 SCA (2017) Tragic saiga deaths in Mongolia. <http://www.saiga->
 461 [conservation.org/2017/01/11/tragic-saiga-deaths-in-mongolia/](http://www.saiga-conservation.org/2017/01/11/tragic-saiga-deaths-in-mongolia/). Saiga Conservation
 462 Alliance. Accessed on 29 March 2017.
 463 Sherwood, P. (2000) Patterns of use of complementary health services in the south-west of
 464 Western Australia. *The Australian Journal of Rural Health*, 8(4), 194–200.
 465 Shih, C. C., Liao, C. C., Su, Y. C., Tsai, C. C. & Lin, J. G. (2012) Gender differences in
 466 traditional Chinese medicine use among adults in Taiwan. *PLOS ONE*, 7(4), e32540.
 467 Solomon, J., Jacobson, S., Wald, K. & Gavin, M. (2007) Estimating illegal resource use at a
 468 Ugandan Park with the randomized response technique. *Human Dimensions of Wildlife*,
 469 12 (2), 75–88.
 470 Szolnoki, G., Hoffman, D. (2013) Online, face-to-face and telephone surveys – comparing
 471 different sampling methods in wine consumer research. *Wine Economics and Policy*, 12,
 472 57–66.

473 Theng, M. & Krishnasamy, K. (*In Press*). *An Assessment of trade in Saiga horn in Singapore*.
474 TRAFFIC Southeast Asia, Petaling Jaya, Selangor, Malaysia.

475 Warchol, G. L. (2007) The transnational illegal wildlife trade. *Criminal Justice Studies*,
476 17(1), 57–73.

477 Wasser, R. M. & Jiao, P. B. (2010) *Understanding the Motivations: The First Step Toward*
478 *Influencing China's Unsustainable Wildlife Consumption*. TRAFFIC East Asia, China.

479 Zang, Z. (1990) A textual research on the history of lingyang. *Nanjing Chinese Medical*
480 *College Magazine*, 6(1), 57–59.

481 Zhang, L., Wu, S. and Bao, Y. (2008). Current status of Chinese pangolin *Manis pentadactyla*
482 in the wild: a rapid range wide population assessment. In: *Proceedings of the Workshop on*
483 *Trade and Pangolins Native to South and Southeast Asia, 30 June-2 July 2008, Singapore*
484 *Zoo* (eds. S. Pantel & S. Y. Chin), pp 103. TRAFFIC Southeast Asia, Petaling Jaya,
485 Selangor, Malaysia.

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488 **Biographical sketches**

489

490 **Meryl Theng's** research interests are in understanding the impacts of wildlife trade and
491 environmental change on wild animal populations.

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493 **Jenny A. Glikman** is the social scientist of the San Diego Zoo's Institute for Conservation
494 Research. She develops and helps establish human dimensions research in community-based
495 conservation programs globally.

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497 **E.J. Milner-Gulland's** research is focused on better understanding and influencing human
498 behaviour and its impact on natural systems. Her website is www.iccs.org.uk.



Plate 1. Saiga horn product types available in Singapore (left to right: whole horns, shavings, tablets, ‘cooling’ waters. Far right: a ‘cooling’ water brand from the supermarkets which does not contain saiga horn).

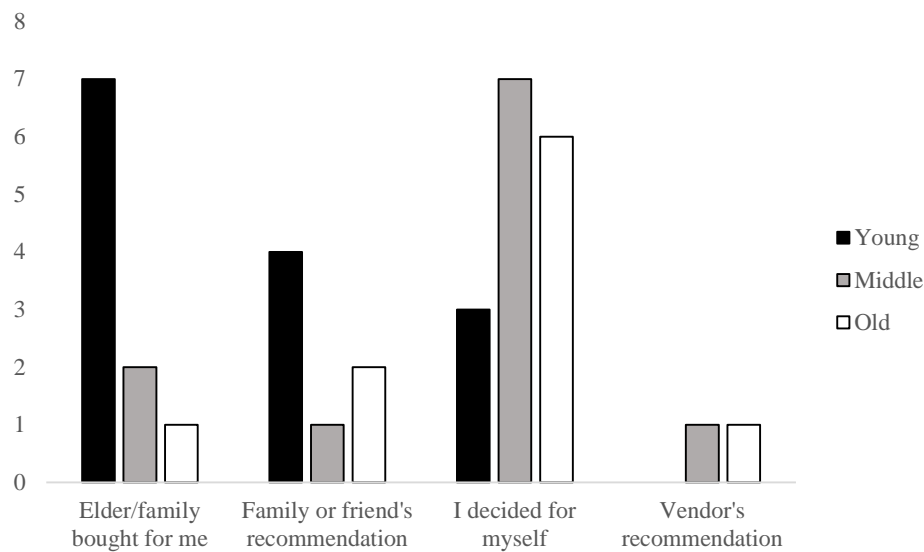
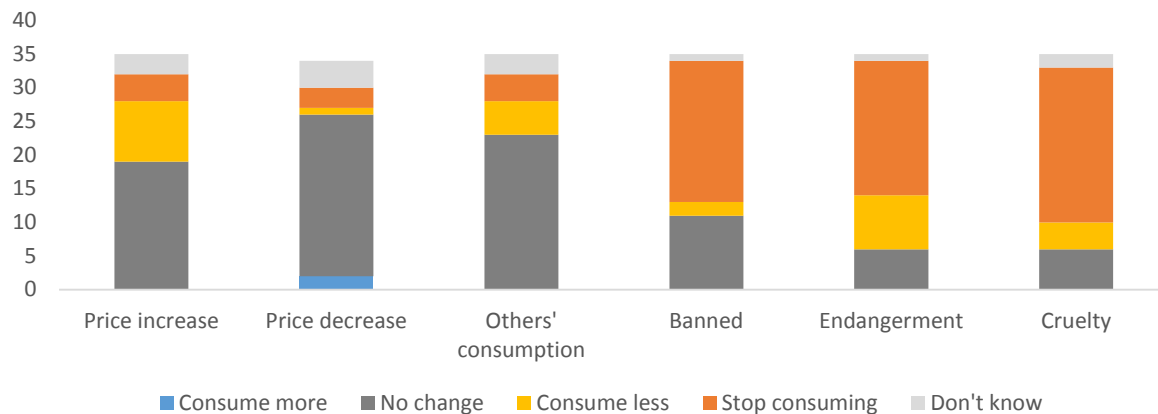


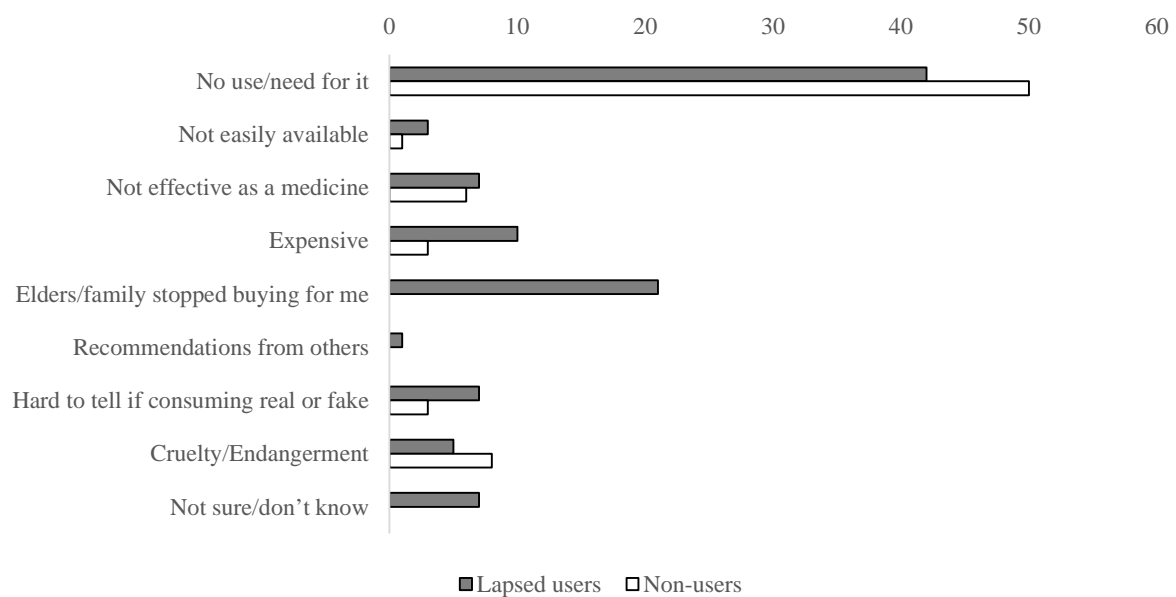
Plate 2. Reasons for the most recent consumption of saiga horn among ‘users’ according to age group (n=35).



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510 Plate 3. The factors that user respondents cited would/would not lead to a change in personal
 511 consumption of saiga horn products (n=35).

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514 Plate 4. Reasons for stopping or not consuming saiga horn, according to lapsed users (n=94)
 515 and non-users (n=105). Respondents were allowed to select up to three reasons.

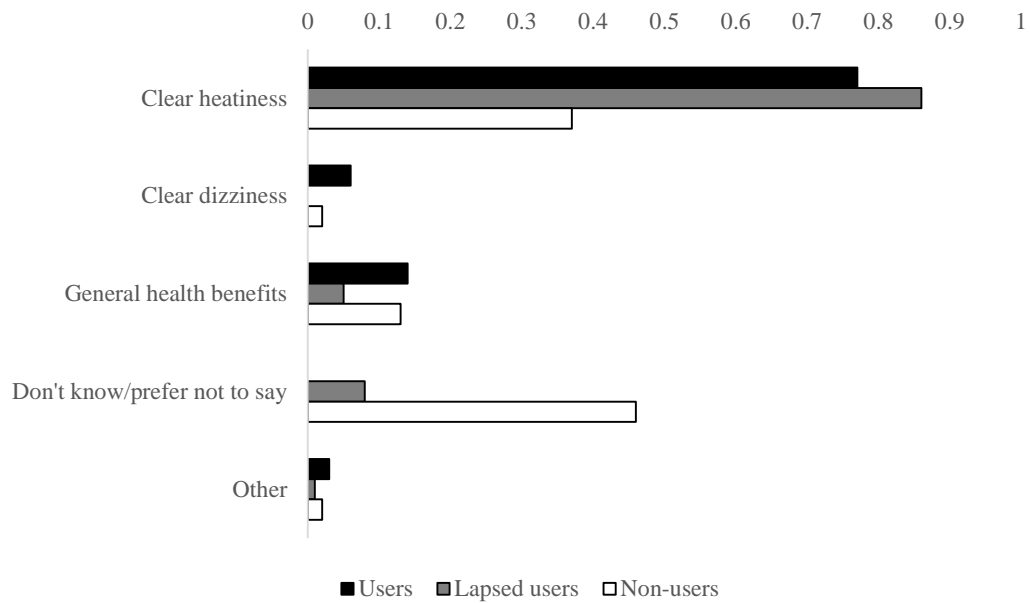


Plate 5. The main reason why saiga horn is consumed, according to users (n=35), lapsed (n=94) and non-users (n=105).

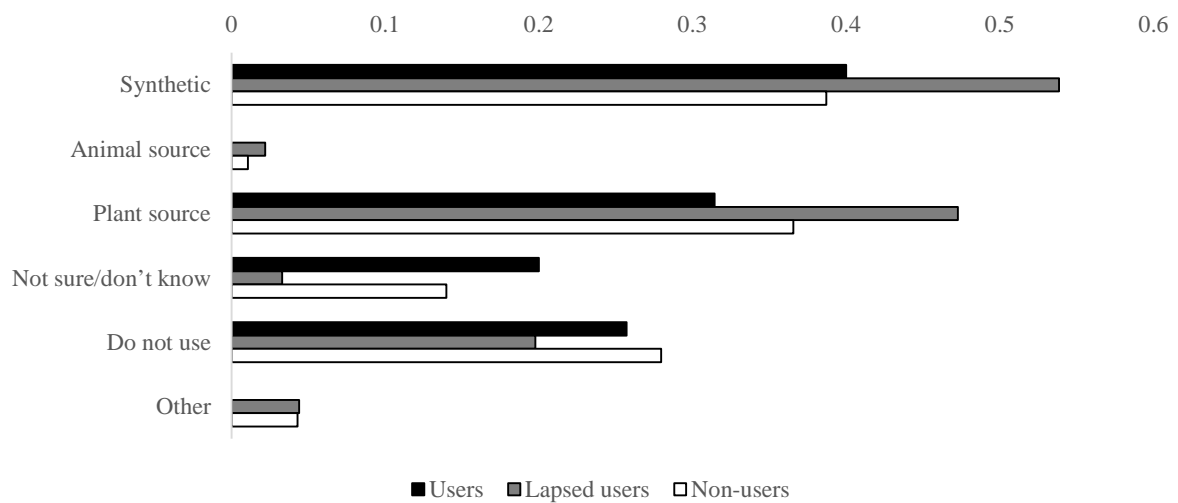


Plate 6. Proportion of users (n=35), lapsed (n=91) and non-users (n=93) that consume each type of saiga horn alternative.