

The use of bear parts as traditional Khmer medicine in Cambodia

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Paper submitted 22 February 2023, revised manuscript accepted 27 December 2023.

មូលន័យសង្ខេប

សត្វខ្លាឃ្មុំ *Ursus thibetanus* និងសត្វខ្លាឃ្មុំតូច *Helarctos malayanus* មានដើមកំណើតនៅព្រះរាជាណាចក្រកម្ពុជា និងនៅតំបន់អាស៊ីអាគ្នេយ៍។ ការជួញដូរខុសច្បាប់ និងការប្រើប្រាស់បំណែកសត្វខ្លាឃ្មុំធ្វើឱ្យសត្វបុរាណជាបញ្ហាប្រឈមដ៏ចម្បងមួយនៅក្នុងការអភិរក្សប្រភេទសត្វខ្លាឃ្មុំទាំងនោះ ដោយបង្កឱ្យមានកំណើននៃការបរបាញ់សត្វខ្លាឃ្មុំព្រៃកាន់តែខ្លាំង និងជំរុញឱ្យមានការបង្កើតសិទ្ធិសត្វខ្លាឃ្មុំនៅប្រទេសមួយចំនួនដើម្បីផ្គត់ផ្គង់តម្រូវការឱសថបុរាណ។ ការយល់ដឹងអំពីប្រភេទអ្នកប្រើប្រាស់ និងការប្រើប្រាស់បំណែកសត្វខ្លាឃ្មុំធ្វើឱ្យសត្វបុរាណ មានសារៈសំខាន់សម្រាប់ការរៀបចំយុទ្ធសាស្ត្រអភិរក្សដ៏មានប្រសិទ្ធភាពដោយផ្ដោតទៅលើកត្តាដែលជំរុញឱ្យមានការប្រើប្រាស់បំណែកសត្វខ្លាឃ្មុំធ្វើឱ្យសត្វ។ បំណែកសត្វខ្លាឃ្មុំរបស់សត្វខ្លាឃ្មុំត្រូវបានប្រើប្រាស់ក្នុងវិស័យវេជ្ជសាស្ត្របុរាណខ្មែរសម្រាប់ធ្វើជាឱសថព្យាបាលជំងឺ និងជំនឿអរូបិយ។ យើងបានធ្វើការដកស្រង់ផ្នែកខ្លះនៃទិន្នន័យពីការសិក្សារបស់ Lim *et al.* (2022) ដើម្បីស្វែងយល់ថាតើការប្រើប្រាស់បំណែកសត្វខ្លាឃ្មុំកំពុងកើនឡើងនៅក្នុងវិស័យវេជ្ជសាស្ត្របុរាណខ្មែរដែរឬទេ ហើយតើវាជាទំនោរនៃការប្រើប្រាស់ដែលរងឥទ្ធិពលពីខាងក្រៅក្នុងអំឡុងពេលប៉ុន្មានឆ្នាំចុងក្រោយនេះ ឬមាននៅក្នុងប្រវត្តិសាស្ត្ររបស់វេជ្ជសាស្ត្របុរាណខ្មែរយូរលង់មកហើយ។ យើងបានធ្វើការសម្ភាសន៍អ្នកប្រកបរបរវេជ្ជសាស្ត្របុរាណខ្មែរចំនួន៣៣នាក់ នៅទីជនបទក្នុងខេត្តស្ទឹងត្រែង និងខេត្តមណ្ឌលគិរី ព្រមទាំងនៅមជ្ឈមណ្ឌលជាតិស្រាវជ្រាវវេជ្ជសាស្ត្របុរាណ និងសមាគមន៍គ្រូឱសថបុរាណខ្មែរនៅទីក្រុងភ្នំពេញដោយប្រើកម្រងសំនួរ semi-structured interviews។ លទ្ធផលនៃការសិក្សានេះបង្ហាញថា ប្រមាត់ខ្លាឃ្មុំត្រូវបានគេយល់ថាជាឱសថដ៏មានតម្លៃ និងគុណភាពខ្ពស់ ហើយអ្នកប្រកបរបរវេជ្ជសាស្ត្របុរាណខ្មែរបាននិយាយថាមនុស្សនៅតែត្រូវការវា។ ទោះជាយ៉ាងណាក៏ដោយ ការឱ្យប្រើបំណែកសត្វខ្លាឃ្មុំសម្រាប់ព្យាបាលជំងឺមានការថយចុះអំឡុងពេលប៉ុន្មានឆ្នាំចុងក្រោយនេះ ហើយអ្នកប្រកបរបរវេជ្ជសាស្ត្របុរាណខ្មែរគិតថាការថយចុះចំនួនសត្វខ្លាឃ្មុំព្រៃនៅកម្ពុជាដោយសារការបាត់បង់ទីជម្រក។ អ្នកប្រកបរបរវេជ្ជសាស្ត្របុរាណខ្មែរមិនសូវឱ្យបំណែកសត្វខ្លាឃ្មុំទៅអ្នកជំងឺទេ ប៉ុន្តែពួកគាត់ណែនាំឱ្យអ្នកត្រូវការប្រើប្រាស់រកបំណែកសត្វខ្លាឃ្មុំដោយខ្លួនឯង។ អង្គការអភិរក្សដែលធ្វើការលើការកាត់បន្ថយតម្រូវការនៃការប្រើប្រាស់ទឹកប្រមាត់ខ្លាឃ្មុំគួរសហការជាមួយមជ្ឈមណ្ឌលជាតិស្រាវជ្រាវវេជ្ជសាស្ត្របុរាណ សមាគមន៍គ្រូឱសថបុរាណខ្មែរ និងអ្នកប្រកបរបរឱសថបុរាណខ្មែរ ដើម្បីលើកកម្ពស់ឱ្យមានជម្រើសប្រើប្រាស់ឱសថផ្សេងទៀតប្រកបដោយនិរន្តរភាពដូចជាឱសថរុក្ខជាតិ។ នេះគឺជាយុទ្ធសាស្ត្រដ៏សំខាន់សម្រាប់អនុវត្តនៅតំបន់ជនបទដែលការប្រើប្រាស់ឱសថបុរាណខ្មែរនៅមានអត្រាខ្ពស់នៅឡើយ។

CITATION: Lim T., Davis, E.O., Crudge, B., Roth V. & Glikman, J.A. (2024) The use of bear parts as traditional Khmer medicine in Cambodia. *Cambodian Journal of Natural History*, 2024, 57–65.

Abstract

Asiatic black bears *Ursus thibetanus* and sun bears *Helarctos malayanus* are native to Cambodia and Southeast Asia. Illegal trade and use of their body parts for traditional medicine are among the main conservation challenges facing these species, because they increase hunting pressure on wild populations and motivate bear farming in certain countries to supply demand for traditional medicine. Understanding the types of consumers and use of bear parts as traditional medicine is crucial to design effective conservation strategies that target the motivations of users of bear part medicine. Bear parts have been used in traditional Khmer medicine (TKM), both as medicinal remedies and in spiritual practices. We explored a subset of data from Lim *et al.* (2022) to understand whether the use of bear parts is growing in TKM and if it has been influenced by external factors in recent years or whether it has occurred throughout the history of TKM. We conducted semi-structured interviews with 33 TKM practitioners in rural areas in the Stung Treng and Monduliri provinces, at the National Center for Traditional Medicine and in TKM associations in Phnom Penh, Cambodia. Our results suggest bear gallbladders are perceived as valuable and high-quality medicine and practitioners stated that people still demand it. However, prescriptions have decreased in recent years and practitioners attribute this to declines in bear populations in Cambodia due to habitat loss. Practitioners are less likely to provide bear parts to patients, but may influence demand by advising them to seek these out. Conservation organisations seeking to reduce demand for bear bile should engage with the National Center for Traditional Medicine and other TKM associations and practitioners to promote sustainable alternatives such as plant-based medicines. This is a particularly important strategy to apply in rural areas, where use of TKM appears to be higher.

Keywords *Helarctos malayanus*, practitioners, semi-structured interview, sustainable use, *Ursus thibetanus*, wildlife trade.

Introduction

Throughout human history, people have used traditional medicine derived from natural resources such as plants, animals and minerals (Alves & Rosa, 2005). The World Health Organization reports that 80% of people in developing countries still rely on animal- and plant-based medicine for primary health care, especially where natural resources are part of their livelihoods (WHO & MOH, 2012). The use of wild animal parts and derived products (e.g., skins, bones, tusks, bile & feathers) for traditional medicine is one of the major threats driving the loss of biodiversity worldwide (Alves & Rosa, 2013; Ogada *et al.*, 2016; Alves *et al.*, 2018). For instance, traditional Chinese medicine (TCM) uses over 1,500 animal species and is traded worldwide, whereas 15–20% of Ayurvedic medicine (India) is based on animal-derived substances (Alves & Rosa, 2005). Alves & Rosa (2013) found that body parts of 108 species of carnivores have been exploited for use in traditional medicine worldwide and nearly half of species listed on the *IUCN Red List* as Near Threatened to Critically Endangered are used as medicine or food.

Bears (Ursidae) are one family of wildlife that are threatened by illegal trade and use for medicine. All bear species are listed in Appendix I or II of the *Convention on International Trade in Endangered Species of Wild Fauna and Flora*, which regulates trade in live bears and bear parts

and products (MAFF, 2002; CITES, 2021). Bear parts are in high demand for traditional medicine worldwide but particularly in Asia (e.g., Davis *et al.*, 2019a, b, 2020a–c; Davis & Glikman, 2020; Hinsley *et al.*, 2021; Davis *et al.*, 2022). Demand for bears is a serious threat to the conservation of Asian bear species because it increases hunting pressure on wild populations and motivates farming of bear bile to supply the demand (Alves & Rosa, 2013; Livingstone & Shepherd, 2016; WWF, 2016; Crudge *et al.*, 2019).

In this study, we focus on two bear species native to Southeast Asia which are threatened by widespread trade in their parts for traditional medicine: Asiatic black bears *Ursus thibetanus* and sun bears *Helarctos malayanus* (Burgess *et al.*, 2014). Populations of both species have declined by $\approx 30\%$ over the last 30 years (Scotson *et al.*, 2017; Garshelis & Steinmetz, 2020). Cambodia may hold regionally significant populations of bears (Gray *et al.*, 2017a), but these are threatened by high levels of trade and known consumption of their parts (Burgess *et al.*, 2014; Davis *et al.*, 2019a, b, 2020a–c). Although national legislation exists to protect wildlife in Cambodia, these laws are poorly enforced in most areas and illegal hunting—particularly the use of snares—remains a significant threat to all large fauna (Gray *et al.*, 2017b, 2021; Marx *et al.*, 2020). In the Cardamom Rainforest Landscape of southwestern Cambodia, the largest

mammalian predators, tigers *Panthera tigris* and leopards *P. pardus*, are likely to be now extinct, with dhole *Cuon alpinus* and bears the largest carnivores remaining (Gray *et al.*, 2017a). Since 1997, over 200 Asiatic black bears and sun bears have been rescued from illegal wildlife trade in Cambodia (Free the Bears, unpubl. data), indicating that the hunting and trade of bears is a considerable threat. Marx *et al.* (2020) reported that two of three released sun bears in a protected area were killed by snaring. Bear parts, in particular the gallbladder, are highly sought-after for use in traditional medicine (TM) in Cambodia and throughout the region (Burgess *et al.*, 2014).

Bear gallbladder has been used in TCM for over 2,000 years to treat a variety of illnesses (Feng *et al.*, 2009). Recent research in Cambodia has documented widespread use of bear bile or gallbladder as medicine to treat ailments ranging from bruises to menstrual bleeding (Davis *et al.*, 2019a, 2020b, 2020c). These findings are concerning from a conservation standpoint, as the practice poses a threat to wild bear populations. However, little is known about traditional practices of using bear bile in Cambodia and specifically, whether these are an inherent component of traditional Khmer medicine (TKM), or a more recent addition due to the influence of TCM and/or other medicinal systems, such as traditional Vietnamese medicine, which also prescribe bear bile (Feng *et al.*, 2009; Davis *et al.*, 2019b).

In Cambodia, TKM is still widely used, possibly due to long-standing acceptance in Khmer culture and poor access to western medicines (Richman *et al.*, 2010). Ros *et al.* (2018) estimated that 40–50% of rural populations in Cambodia still depend on TM for primary health care, although this use may be more “informal” than in previous decades e.g., individuals are less likely to actively consult a TM practitioner (Meessen *et al.*, 2011; Lim *et al.*, 2022). Like some other TMs, TKM ingredients are derived from plants, animals and also minerals (Hieng *et al.*, 2011). Wildlife species cited in the Khmer medicine pharmacopeia by Hieng *et al.* (2011) include mammals, reptiles, birds, aquatic animals and insects, along with specific organs used e.g., rhino horn, tiger bone, bear gallbladder, porcupine stomach or pangolin scale.

Lim *et al.* (2022) showed that animal products are frequently used in contemporary practices of TKM. They also found that loris species *Nycticebus* sp. were most commonly reported in TKM (49% of respondents), followed by serow *Capricornis sumatraensis* (39%) and porcupine (*Hystricidae* spp., 27%). Bear parts were the fifth most commonly reported wildlife parts used by respondents (15.2%) in the five years prior to the research, yet were also reported as the most commonly

prescribed parts (36.4%) prior to this (i.e. more than five years previously) (Lim *et al.*, 2022).

The aim of our study was to explore the use of bear parts in TKM using a subset of data collected by Lim *et al.* (2022) that focuses on this topic. We also aimed to investigate the history of bear part use in TKM. This research is particularly relevant for behavioural interventions that aim to reduce the use of bear bile and bear gallbladders in rural areas of Cambodia as well as possible alternatives that might be acceptable to communities in these areas.

Methods

Semi-structured interviews

We conducted semi-structured interviews with TKM practitioners in rural areas of Cambodia where we assumed based on the number of health centres that people have limited access to western medicine and are more reliant on TM. We also interviewed teachers of TKM at the National Center of Traditional Medicine and TKM associations. The interview was divided into subsections intended to investigate: TM practice in general (e.g., what type of schooling practitioners may have, where their knowledge came from, etc.); use of wildlife (animal and plant) products in TKM; specific applications of bear-derived medicinal products (e.g., which ailments are treated, how the products are used); and how TKM has changed over the course of the practitioners’ lives. The interview can be found as an appendix to Lim *et al.* (2022). The study was carried out between June 2018 and January 2019. NVivo (vers. 12) was used to analyse the data in terms of visualizing, classifying, sorting and arranging the data into themes.

Study areas

Our study was undertaken in Stung Treng Province (13°31' N, 105°57' E) and Mondulkiri Province (12°27' N, 107°14' E) in northeast and east Cambodia, respectively. With a total area of 11,092 km², Stung Treng is the least densely populated province in Cambodia and abuts the border with Laos (NIS, 2013a). Following Khmer, the most prevalent ethnicity in the province is the Lao people (Try & Chambers, 2006). Mondulkiri, which borders Vietnam to the east, has a total area 14,288 km² and is one of the largest provinces in Cambodia. The most common indigenous group are the Bunong people (NIS, 2013b). These provinces were selected for the study because they have large areas of forest with rich biodiversity and are less developed with fewer medical clinics where

people can access western medicine (Open Development Cambodia, 2016).

Sampling strategy

We interviewed TKM practitioners who comprised traditional Khmer healers (*Kru Khmer*), traditional birth attendants / grandmother midwives (*Chhmob boran* or *Yei y mop*) and Buddhist monks—who practice TKM in addition to performing exorcism ceremonies and spiritual healing based on Buddhist principles (Ovesen & Trankell, 2010). We also interviewed key informants from the National Center for Traditional Medicine, the Cambodian Traditional Healer Association and the Association of Traditional Cambodian Medicine in Phnom Penh. As we had no prior information about the TKM practitioners in our study areas, convenience and snowball sampling were employed (Etikan *et al.*, 2016; Parker *et al.*, 2020). As such, the first village in each study area was randomly selected and on arrival there, we asked village chiefs for the location of TKM practitioners. After we interviewed a few TKM practitioners in each village, we used snowball sampling to find other practitioners, although we found that TKM practitioners did not like to introduce other practitioners because they were direct competitors for clients.

Ethical approval

This study was approved by the relevant agencies in study areas, as well as the Cambodian Ministry of Environment. Ethical approval was granted by the Miami University of Ohio's Internal Review Board (Protocol ID: 02106e). All respondents were informed of their confidentiality and told they could stop the interview at any time. All interviews were conducted by the lead author and an assistant note taker who directly transcribed the interview as it occurred in Khmer (national language of Cambodia). Once transcribed, all respondents were assigned a random ID and to ensure their confidentiality, the physical interview documents were kept in a sealed cabinet in a locked office in Phnom Penh, which only the study authors had access to. For additional details of the study methods, please refer to Lim *et al.* (2022).

Results

Demographic information

We interviewed a total of 35 people who comprised TKM practitioners in Stung Treng ($n=20$) and Mondulhiri ($n=10$) and key informants ($n=5$) in Phnom Penh. Of the five key informants, two were institutional management staff and three were TM teachers and researchers

who actively practice TKM. As such, data provided by the latter were pooled with other TKM practitioners in the relevant analyses. Overall, we interviewed 25 men and 10 women, with an average age of 62 years. All of the participants still practiced TM and had 25 years of experience on average, with only 12% ($n=4/33$) of interviewees having practiced for less than five years. On average, our respondents met 31 people seeking treatment or purchasing TM each month. The ethnicities of our respondents were: Khmer ($n=20/33$), Khmer-Lao ($n=8/33$), Lao ($n=3/33$), Bunong ($n=1/33$) and Khmer-Chinese ($n=1/33$). Further details are provided by Lim *et al.* (2022).

Use of bear parts in TKM

Nearly all respondents including TKM teachers at the National Center for Traditional Medicine and Association of Traditional Cambodian Medicine ($n=32/33$) reported that bear parts were historically used in TKM, although the uses varied depending on the parts employed. When asked which bear parts can be used in TKM and what ailments these may be used to treat, gallbladder was most commonly identified by respondents ($n=31/33$), followed by liquid bile ($n=29/33$). Both were reported as valuable medicine and identified as the most sought-after bear parts, with four respondents comparing the price to gold.

“Oh, not easy to find bears, but if we can get one bear we will become the rich person, will be “tilt the village” [idiom] because the bear’s gall bladder is expensive like the gold, they use the gold scale to weight it and sell...” [Female, 41, Khmer-Lao, TKM healer, Stung Treng]

“Yes, bear bile and gallbladder are TKM too, it is the high-quality medicine because it is as expensive as gold. My brother who lives at Koh Kong province, used to be the middleman who find to buy bear from hunters since 1990s...” [Key informant #3, Phnom Penh]

Bear gallbladder was reported to have the same medicinal effect as liquid bile and as used much more than the latter. Although well known to practitioners, liquid bear bile was reported as being infrequently used in practice. Gallbladders used for medicine were generally reported to be sun-dried or roasted. The dry bear gallbladder was said to be chopped into small slices, soaked in local wine, or rubbed with water (*Thnam dos*). Bear gallbladder and/or bile were frequently prescribed for ailments including body pain ($n=6$), as a tonic ($n=5$), internal/external bruising ($n=4$), diabetes ($n=3$), cool medicine & fever ($n=2$), improving vision ($n=2$) and post-partum treatment ($n=2$). Bear gallbladder was also reported by at least one respondent as used to treat various other illnesses including chicken pox, HIV, kidney disease, heart disease, gallbladder disease,

cancer, lung and liver disease, headache, haemorrhoids and insomnia (Table 1).

In descending order, other bear parts valued for TKM included the claws ($n=30/33$), teeth ($n=26/33$), bone ($n=26/33$), blood ($n=23/33$), paw ($n=22/33$) and skin ($n=16/33$) (Table 1). Respondents reported that bear claws are frequently used in spiritual treatments as a necklace pendant ($n=11$). The purpose was for a child or newborn baby to wear these to protect them from spirits called "Old mother" (*Preay Madai Derm*) who wake babies up and make them cry at night. Bear claw pendants were also used by older people to bring luck and power, and as "rubbed medicine" for fever ($n=5$) and body pain ($n=2$). Teeth were also used in a similar manner as claws in being worn as a necklace for protection against bad luck and danger ($n=10$), and employed as rubbed medicine for cooling and treatment of fevers ($n=2$). Bear bone was soaked in rice wine or ground on stone and drunk in rice wine or water to treat body pain ($n=4$), or applied on the skin as a healing agent for wounds and dermatoses ($n=4$), a cooling medicine for fever ($n=3$) and for internal/external bruising ($n=2$). People also drank bear blood mixed with rice wine to treat body pain ($n=8$) and internal/external bruising ($n=4$), as a general tonic ($n=4$) and for women to get fair skin ($n=2$). Paws were roasted or soaked in rice wine or made into a soup used for body pain ($n=7$) and as a tonic ($n=5$). They were also reported by at least one respondent as being used to improve sexual ability, to treat myelodysplastic syndromes and fever, or used as an antibiotic or healing agent. Skin was roasted and powdered to use for healing agent for dermatoses ($n=5$) and when soaked in wine, used for respiratory illnesses such as asthma and tuberculosis ($n=2$).

Sourcing bear parts

Similar to other wildlife used in TKM (Lim *et al.*, 2022), our results suggest that use of bear parts has declined in recent years: five of 33 practitioners reported using bear parts in the five years prior to the survey, whereas 12 reported using these in the time before that. Bear parts were typically obtained from the wild, where the bears were killed and the valuable parts harvested. All of the 12 respondents that historically prescribed bear parts reported that they had purchased these directly from hunters, with some adding that they had requested hunters to target bears. In the five years before the survey, respondents tried methods such as purchasing from hunters ($n=3/5$), seeking to buy from markets ($n=1/5$), TCM shop ($n=1/5$) and from another country ($n=1/5$), where the practitioner reported getting bear parts from Myanmar through Laos to Cambodia. Hesitancy to speak openly about use of high-profile wildlife and the need

for discretion when buying parts (Lim *et al.*, 2022) indicates that the practitioners we interviewed understood that hunting and purchase of bear parts is against the national law. They also understood that bears are increasingly rare in the wild, and that this is why these are now more difficult and expensive to obtain. However, even respondents that said they had never used bear parts or had not used them in the previous five years mentioned that clients still request these. Some also reported that they were still asked by rich and high-status customers to obtain bear parts.

"In past five years, I use only alternative plant medicines to bear parts because I could not find them anymore. But there still have people who come to ask me but I could not find for them. Now is no more forest, so it is hard to find bears. In past 40 years, there were a lot of bears; it was easy for me to contact to hunters for buying. I used to pet them as well, I got two bears, one of them I just got it by exchanging with 1 rice sack which 50kg rice to hunter. The most of people who asked me to find bear parts were high status person, Ouknha status." [Female, 68, Khmer-Lao, TKM practitioner & traditional birth attendant, Stung Treng]

"It is very difficult to get them during these past five years because there is no more forest in Cambodia; it is substituted by cashew nut and rubber fields. If we want, we can buy from Vientiane in Laos, but it is so expensive...; Nowadays, it's imported from Burma to Laos, then to Cambodia. In past 40 years, it was easy to find. Since after Pol Pot regime, other countries bought those parts from us." [Male, 54, Khmer-Lao, TKM practitioner & Khmer healer, Stung Treng]

When asked how they were more likely to act, most practitioners ($n=17/33$) declined to answer, whereas some ($n=9/33$) said that they would advise bear products to people suffering from an ailment that they knew could be treated with these and others ($n=7/33$) reported that they would supply bear products if requested to.

Gallbladder and bile from different bear species

When asked which bear species provides the most medicinally effective gallbladder and/or bile, most respondents ($n=22/33$) stated that they did not know, whereas some ($n=7/33$) believed that Asiatic black bear and sun bear have the same medicinal properties. Three regarded Asiatic black bears as more desirable, although all respondents suggested that this was not related to medical efficacy but to the larger size of the species which has a bigger gallbladder and produces more bile liquid. Only one practitioner regarded the gallbladder of sun bears as being more effective due to the belief that its diet mainly comprises honeybees, which results in the gallbladder containing high concentrations of medicinal ingredients.

Table 1 Bear parts used in traditional Khmer medicine and their associated ailments, according to TKM practitioners.

Bear parts	Confirmed as TKM		Used for (no. of practitioners)
	<i>n</i>	%	
Gallbladder	31	94	Body pain (6), tonic (5), internal/external bruising (4), diabetes (3), cool medicine and fever (2), improving vision (2), post-partum treatment and women-related ailments (1). Other (<i>n</i> =1): shattered head, chickenpox, HIV, kidney disease, heart disease, gallbladder disease, cancer, lung disease, liver disease, sleeping pill, headache, haemorrhoids.
Bile	29	88	Body pain (7), tonic (6), internal/external bruising (4), diabetes (4), cool medicine and fever (3), post-partum treatment and women-related ailments (2). Other (<i>n</i> =1): shattered head, chickenpox, HIV, kidney disease, heart disease, gallbladder disease, cancer, lung disease, liver disease, sleeping pill.
Claws	30	91	Worn to protect from bad spirits (11), cool medicine and fever (rubbed medicine) (5), body pain (2). Other (<i>n</i> =1): inner organ disease, post-partum treatment, healing agent, headache, malaria, internal bruising.
Teeth	26	79	Personal protection (spiritual belief) (10), cool medicine and fever (2). Other (<i>n</i> =1): healing agent, tonic, post-partum treatment, bruising.
Bone	26	79	Body pain (4), healing agent for dermatosis (4), cool medicine and fever (3), internal/external bruising (2). Other (<i>n</i> =1): myelodysplastic syndromes, inner organ disease, female urethritis, personal protection.
Blood	23	70	Body pain (8), tonic (4), internal/external bruising (4), getting fair skin (2). Other (<i>n</i> =1): myelodysplastic syndromes, sexually transmitted diseases, post-partum treatment, diabetes, lung disease.
Paws	22	67	Ailments related to body pain (7), tonic (5). Other (<i>n</i> =1): improving sexual ability, myelodysplastic syndromes, antibiotic, healing agent, fever.
Skin	16	48	Healing agent for dermatosis (5), asthma (2), tuberculosis (2). Other (<i>n</i> =1): post-partum treatment, cancer, scrofula, internal/external bruising.

Alternatives to bear parts

According to almost half of our respondents (*n*=15/33), ailments that can be treated with bear gallbladder and bile can alternatively be treated with plant-based medicine. The specific alternative depends on the type of illness and the experience of the practitioner. However, the identity of these plant-based alternatives was not clearly reported and we are not aware of any official documents that support this suggestion. Some respondents (*n*=7/33) refused to identify the alternative plants and ingredients because they were hesitant to share their knowledge, whereas others (*n*=8/33) did not know of alternatives. One respondent stated that he could not share the information because according to rules of practice provided by his teacher, he could provide medicines but not information on their ingredients. Another possible reason why practitioners might not have wanted to share certain information is that they may have felt their knowledge was not supported by the official texts on TKM, such as the *Traditional Medical Treatments—Translated from Ancient Khmer Palm-Leaf Manuscript* used by the National Center for Traditional Medicine. The TKM practitioners

we interviewed commonly reported that they had learnt their skills from kin who were practitioners that had not been formally trained. They also noted that they remembered the remedies without having written records or reference books for these.

Although plant-based alternatives were reported as substitutes by some respondents, bear gallbladder and bile were still perceived as the most effective medicine in TKM. For instance, respondents stated that bear gallbladder can help the speedy recovery from illnesses faster than alternatives. However, respondents did cite plant-based medicines which could treat illnesses also treated with bear bile such as body pain, fever and post-partum disorders, which are common ailments. One respondent who noted that bear gallbladder is used to treat illnesses such as HIV, cancer, lung disease and liver disease also stated that there is no alternative, while another noted that bear gallbladder can be substituted with elephant ivory for treating serious illnesses. These reported uses are not supported by TKM texts employed by the National Center for Traditional Medicine.

Discussion

Our study indicates that several bear parts including dry gallbladder, bone, blood and paws were historically used in TKM. Among these parts however, only bear gallbladder is explicitly mentioned in the Khmer medicine pharmacopeia—*Materia Medica* (Hieng *et al.*, 2011). This text is used in training courses for TM practitioners and health subject students at the National Center for Traditional Medicine in Phnom Penh. However, the illnesses for which bear gallbladder are prescribed by our respondents are not mentioned in this. According to a key informant at the centre, the use of wildlife parts is only mentioned in Hieng *et al.* (2011) as an introduction to animal-based medicine and the centre does not encourage use of wildlife in medicine. Our respondents also reported that liquid bear bile was part of TKM and has the same healing properties as gallbladder. However, the practitioners we interviewed stated they mainly used bear gallbladder in dried form and rarely used liquid bile. Additionally, liquid bile is not mentioned in Hieng *et al.* (2011) and according to informants at the National Center for Traditional Medicine and Cambodian Traditional Healer Association, it does not form a part of TKM practice. As such, knowledge about bear bile could be a recent introduction into TKM practice in Cambodia and an influence of TM practices in China and Vietnam where bear bile extraction occurs (Foley *et al.*, 2011). In response to separate questions, all of our key informants claimed that TKM has been influenced by TM systems in neighbouring countries in recent decades e.g., China, Vietnam, Thailand and Laos. It was further suggested that this influence was because TM products from these countries are imported to Cambodia and because foreign nationals in Cambodia seek such products from their home countries.

We found that bear gallbladders were prescribed to treat common illnesses and improve health (Table 1). Bear bone, blood and paws were also used to treat these ailments. However, claws and teeth were prescribed for spiritual matters such as warding off bad spirits. These results are similar to Davis *et al.* (2020b, 2020c) who found that individuals across Cambodia believe that bear bile and gallbladder are effective for treating certain illnesses. These studies found that bear parts were used for common ailments such bruising, which is consistent with our study. However, our respondents identified further ailments that may be treated with gallbladder and bile. This is to be expected as the TKM practitioners we interviewed would have greater medicinal knowledge than the average member of the general public.

Asiatic black bears produce especially high levels of tauroursodeoxycholic acid, a conjugated form of ursodeoxycholic acid, which is a medicinally active ingre-

dient of bear bile (Hagey *et al.*, 1993; Foley *et al.*, 2011). Historically, the bile of Asiatic black bear has been more sought-after than that of other bear species (Feng *et al.*, 2009; Foley *et al.*, 2011). Although sun bears produce relatively low concentrations of tauroursodeoxycholic acid, their gallbladders are used in TM despite there being no studies confirming their effectiveness (Crudge *et al.*, 2019). Medicinal knowledge is documented in ancient and modern medicine in countries such as South Korea, China and Vietnam, where bear farming has been established to supply TM practices (Foley *et al.*, 2011). This farming led to a decline in wild bear populations due to the need for continual supply of bears to the farms (Feng *et al.*, 2009). While bear farms have yet to be created in Cambodia, the kingdom held the record for the highest number of bear-related seizures between 2000–2011 and is a major source country for the supply of live bears to farms in other countries, as well as the illegal market (Burgess *et al.*, 2014). Our study also supports previous studies that found a relatively high level of domestic demand exists for bear gallbladder and other products in Cambodia (Davis *et al.*, 2020b, 2020c). However, prescription of bear products was apparently higher in historical times, having reportedly decreased in recent years for bears and other wildlife (Lim *et al.*, 2022). The rarity of certain animals and difficulty in finding wildlife products including bear parts was noted by our respondents as having resulted in their replacement with plant-based alternatives. However, they also stated that products such as bear gallbladder are still perceived as high-quality medicine in TKM and that this motivates some practitioners to continue seeking these. Our study highlights that while the supply of bear parts to TKM practitioners may have lessened in recent years, their advice to patients may continue to promote demand for these in TKM. Notwithstanding this, the rural TKM practitioners (such as *Kru Khmer* or *Kru Thnam Khmer*) in our study mostly hailed from relatively poor households. As a result, purchase of valuable bear parts might require more money than these typically possess and so they may be less likely to supply such medicines to customers. As such, they may advise customers on which animal parts they should find by themselves from sources such as hunters, middlemen, other TM shops and markets. Rural communities are often closer to protected areas where bears are still extant and so can more easily access wild bears if they have the right hunting tools (Davis *et al.*, unpubl. data).

Conservation implications

Bears persist in Cambodia despite high levels of habitat loss and illegal wildlife trade and consumption (Burgess *et al.*, 2014, Davis *et al.*, 2019a). Understanding of tradi-

tional knowledge and cultural practices regarding natural resources is important to promote effective communication between conservation communities, TM communities and rural communities, who often live at critical geographic junctions for conservation (Alves & Rosa, 2005; Alves *et al.*, 2020). TKM practice is still important for local primary healthcare in rural areas and we found that consumers of TKM trust the knowledge of TKM practitioners and follow their advice. Lim *et al.* (2022) highlighted that TKM practitioners also have a role in guiding and advising about medicine to patients. Additionally, when it comes to bear parts in TKM practice, we found that practitioners may be less likely to provide bear parts to patients, but may advise people to seek these out. This may contribute to the continued use and trade of bear parts in Cambodia. This behaviour is similar to how TCM practitioners in China informally recommend bear bile to their customers, rather than providing a formal prescription (Hinsley *et al.*, 2021).

Behaviour change interventions should be implemented in rural areas of Cambodia that continue to be more isolated from biomedical facilities. These should encourage the use of plants over animal species in TKM treatments. Because use of bear parts has deep roots in Khmer tradition and is perceived as highly effective, this behaviour may be ingrained and difficult to change. One possible leverage opportunity could be to strengthen pride in natural heritage, similar to the framework of successful RARE Pride campaigns (Butler *et al.*, 2013). Such campaigns could recruit TKM practitioners as spokespeople, drawing on their reliance on the forest and the wildlife within to encourage a conservation ethos. However, such campaigns would need to be carefully researched, designed and tested to ensure that they do not cause unsustainable exploitation of plant species, and/or engender greater interest in animal-based TKM use. This could be accomplished with research that builds on our study, such as focus group discussions with TKM practitioners and local community groups, to identify common plants that could be grown in local communities as a more accessible alternative to bear bile, gallbladder and other animal products.

Acknowledgements

We express our gratitude to the Ministry of Environment in Cambodia for permitting our research and to the National Geographic Society for funding this study (Grant number HJ-119ER-17). The National Geographic Society had no role in the design of the study nor in the collection, analysis and interpretation of data or in writing the manuscript. We are also grateful to Perth Zoo Wildlife Conservation Action grants for ongoing support

of bear conservation research in Cambodia. We also thank Mech Mony for his assistance during data collection and Diogo Verissimo for guidance throughout our research. Finally, we are especially grateful to the provincial authorities in Stung Treng and Monduliri for their permission and all of the respondents who kindly volunteered their time and knowledge.

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