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ORIGINAL PAPER

Comparing conservation priorities for useful plants among botanists and Tibetan doctors

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Abstract Perspectives of diverse constituencies need to be incorporated when developing conservation strategies. In *Menri* (Medicine Mountains) of the Eastern Himalayas, Tibetan doctors and professional botanists were interviewed about conservation of useful plants. We compare these two perspectives and find they differ significantly in conservation priorities (Wilcoxon Signed Ranks $P < 0.05$), both in how they prioritized, as well as the priorities themselves. Tibetan doctors first consider which plants are most important to their medical practice and, then secondarily, the conservation status of these plants. Additionally, perceptions of threatened medicinal plants differ among Tibetan doctors who received medical training in Lhasa, who were local trained, and who were self-taught. In contrast, professional botanists came to a consensus among themselves by first considering the conservation status of plants and then considering use. We conclude that, in order to effect community based conservation, opinions from both Tibetan doctors and professional botanists should be considered in establishing conservation priorities and sustainable conservation programs. Furthermore, we set our own research agenda based on combined perspectives.

Keywords Conservation · Tibetan medicine · Threatened plants · Useful plants · Tibetan doctors

Introduction

In response to inadequate, exclusionary conservation policies, the World Conservation Union (1980) urged a shift in the planning and management of natural

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resources to include local communities. Since then, there has been growing recognition that local communities need to play an active role if biodiversity is to be preserved (Kellert 1985; Fletcher 1990; Gadgil 1992). However, the success of community based conservation (CBC) projects has been mixed, with performance falling short of expectations (Barett et al. 2001). But many of these programs have been unsuccessful because of two main factors: the mixed objectives of conservation and development (Redford and Sanderson 2000) and improper implementation (Songorwa 1999; Murphree 2002). These factors often lead to unfavorable perceptions by local communities often discouraging participation (Mehta and Kellert 1998).

The goals of many CBC programs have been to socially and economically develop rural areas along with biodiversity conservation. Unfortunately, too often, programs have primarily focused on development for economic growth, and assumed that environmental solutions would arise on their own since communities could invest in more resource efficient ways of life (Adams et al. 2004). Alternatively, some development strategies have prioritized high-productivity agriculture over sustainable management of existing resources. Because varying local priorities are often not taken into consideration, receptivity of these development strategies is low or support is not maintained (Marcus 2001). In fact, in planning and implementing CBC projects, programs have often not included local opinions, knowledge, or priorities, and in the worst cases, have primarily used local people as laborers (Songorwa 1999). These types of projects do not earn support from local people since their needs, which vary from community to community, are often not met. Berkes (2004) states that we must utilize the research within interdisciplinary fields that links human and nature and provides a more sophisticated understanding of social–ecological knowledge and a better insight into CBC.

Central to these emerging conservation fields is traditional knowledge (TK).

> ''Traditional knowledge is a cumulative body of knowledge, know-how, practices and representations maintained and developed by peoples with extended histories of interaction with the natural environment. These sophisticated sets of understandings, interpretations and meanings are part and parcel of a cultural complex that encompasses language, naming and classification systems, resource use practices, ritual, spirituality and worldview.'' International Council for Science (2002).

TK of the resource users themselves has been advocated for ecosystem management (Johannes 1978, 1998; Olsson and Folke 2001; Salick et al. 2005). Numerous studies show why and how indigenous knowledge and people can be part of sustainable conservation (e.g., Bennett 1992; Brosius 1997; Salick et al. 2004). In contrast, *not* taking into account TK can hinder formal conservation efforts (Etkin 2002; Chapin 2004).

Local peoples' extensive knowledge of a local area can often surpass some aspects of scientific knowledge if scientists do not reside in that area. Traditional knowledge, passed on from generation to generation, is derived from a close relationship with an environment upon which people depend for their livelihood (Ohmagari and Berkes 1997). TK is frequently very different from scientific knowledge, but when considered together, can be complementary (Berkes et al. 2000).

This is not to downplay the importance or necessity of scientific knowledge. Perspectives of outside experts are also valuable for conservation, since scientists can

provide detailed information about plants and animals, communities, and ecosystems from a larger, regional perspective, often synthesizing information from many sources and providing an overview for the local situation (Sheil and Lawrence 2004).

When community based conservation is informed by TK and properly integrated with scientific knowledge, conservation can be effective (Campbell and Vainio-Mattila 2003).

We examine this relationship between local knowledge and that of outside experts at Mt. Khawa Karpo, NW Yunnan, China. We work with academically trained botanists and with local Tibetan doctors from different cultural settings to determine which medicinal plants and fungi are both most valued and threatened. We analyze the differences among Tibetan doctors with different backgrounds in what plants and fungi they deem valuable. Then we evaluate how views of threatened useful plants and fungi differ between local Tibetan doctors and outside expert botanists.

Study area and peoples

Khawa Karpo, the earthly image of the Tibetan warrior god, is one of the eight sacred mountains in Tibet. It lies on the border of NW Yunnan and Tibet in the easternmost Himalayas (Fig. 1). This area is within a biodiversity ''hotspot'' defined by both WWF/IUCN (Mackinnon et al. 1996) and Conservation International (Mittermeier et al. 1998). It is also home to more than 10 ethnic groups composed of

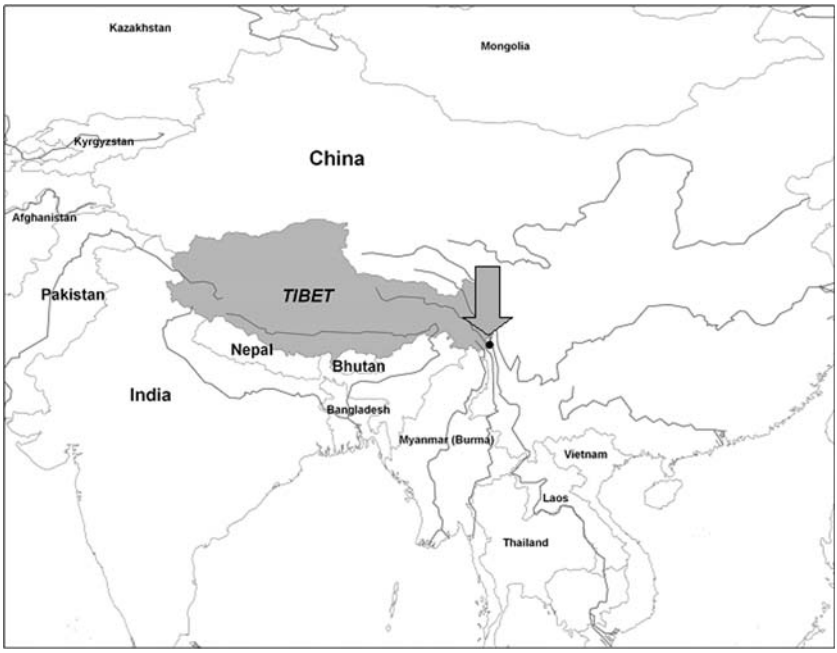

Fig. 1 Khawa Karpo area where this study was conducted

over five million people, with Tibetans in this area comprising approximately 80% of the population (Xu and Wilkes 2004).

Tibetan doctors (Fig. 2) in this area receive training depending on their background. Tibetan monks are often trained in a formal medical system emanating from Lhasa, as well as in traditional Tibetan Buddhism. Of the seven Tibetan doctors practicing medicine around Khawa Karpo, one is a monk and learned medicinal plants and fungi from monastic training. Four of the doctors in our study, which we will refer to as locally trained, were educated locally by medicine men from around Khawa Karpo whose knowledge includes both training in Lhasa and local knowledge. Finally, there were two local village doctors who started as market collectors, who we will call self-trained.

Methods

After receiving prior informed consent, we conducted a semi-structured, open-ended interview in English, with seven local Tibetan doctors practicing in the Khawa Karpo

Fig. 2 Interviews with local Tibetan doctors including (**a**) Lhasa trained monk (left), here shown mentoring living Buddha (right), (**b**) locally trained doctor, (**c**) locally trained doctor (left), here with first author (right), and (**d**) self-trained doctors (2 people on right)

area (Fig. 2) and three academically trained Chinese botanists most familiar with the plants and fungi and people of NW Yunnan province. Both groups were requested to list 20 useful plants with populations that are threatened in the Khawa Karpo area. They informed us of (1) the name of the plant, if possible, both in Tibetan and Chinese, (2) plant use, (3) what part of the plant is used, and (4) the elevation and habitat where the plant can be found.

Interviews differed somewhat due to literacy and language. Tibetans were interviewed in Tibetan using a translator, while botanists were interviewed in English. With doctors, after listing 20 plants, pile sorting was used to distinguish degrees of usefulness and threat. First they separated the medicinal plants and fungi into three categories (1, less useful; 2, useful; 3, most useful). Then they separated these plants and fungi into three categories of threat (1, not threatened; 2, threatened; 3, very threatened). Finally, we asked the doctors to rate the list of plants and fungi given by the botanist into three threat categories (1, not threatened; 2, threatened; 3, very threatened). Scientific plant names were confirmed using (a) medicinal books used by the doctors, (b) *Diqing Zang Yao* (Yang and Chuchengjiancuo 1989), and/or (c) *The Wildflowers in Hengduan Mountains in Yunnan China* (Fang 1993).

We compared the list of plants and fungi and conservation threats identified by Tibetan doctors and by expert botanists. Because data where non-normally distributed, we used the non-parametric, Wilcoxon Rank Sum (SPSS, v.11.0.1 Inc. 2001). In order to look at the similarity of Tibetan medicinal training, we used Non-metric Multidimensional Scaling with Jaccard Distance Measure (NMS; PC-ORD v.4.20; (McCune and Medford 1999) to group doctors by similarities of response by which plants were considered most useful. We statistically compared the parts of plants used, ailments cured, and elevation using likelihood ratio tests in JMP (SAS Institute, version 5.1 2003).

Results

The first result we observed was the differing process by which the plant lists were compiled by the two groups, which in itself is indicative of differing orientations. Botanists worked together to form a single list of threatened useful plants by consensus, considering threat status first and use secondarily, and in the end limited their list to only 17 species upon which they all agreed. Working independently, Tibetan doctors did the reverse, listing useful plants first (having trouble limiting themselves to 20) and then ranking threat secondarily. Botanists named plants and fungi with different uses including medicines and ornamentals (see appendix). In contrast, Tibetan doctors named 20 plants and fungi each that were used medicinally (see appendix). Comparing, we see that only 4 of the plant species occurred on both lists, *Pegaephyton scapilflorum*, *Fritillaria delavayi*, *Fritillaria cirrhosa*, and *Saussurea laniceps*, of which the latter three are popularly marketed species.

The botanists presented a list of useful plants and fungi, *all* of which they thought were most threatened (threat level 3). The doctors' evaluation of the botanists' list of threatened plants and fungi indicated that there were significant differences in opinions of threat status between doctors and botanists (Fig. 3; $Z = -5.03$, $P < 0.0001$).

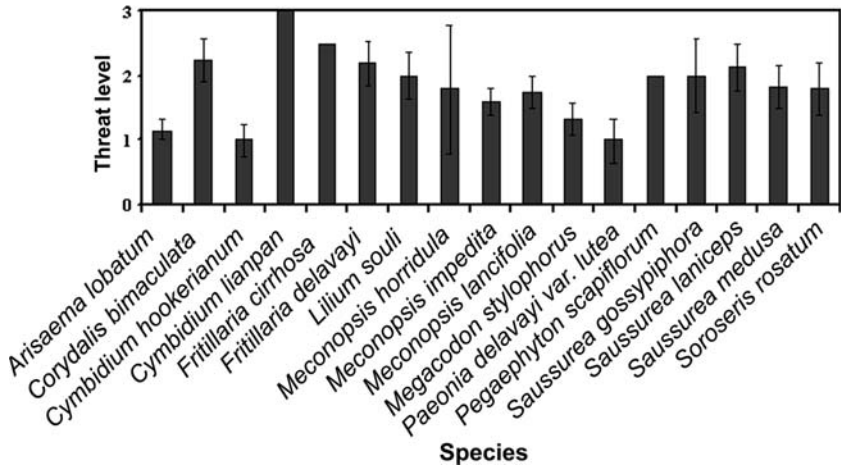

Fig. 3 Threat ratings given by Tibetan doctors (mean ± SE) for botanists' list of threatened and useful plants and fungi. Botanists rated all these plants and fungi as very threatened (value of 3). Tibetan doctors' rankings are significantly different from those of the botanists ($P = 0.001$, Wilcoxon Signed Ranks test)

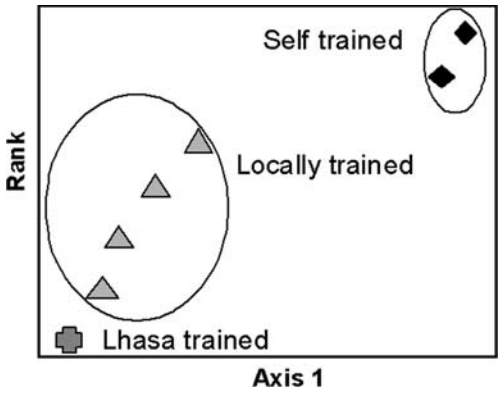

Fig. 4 Tibetan doctors' most useful medicinal plants and fungi are ordered by Non-metric Multidimensional Scaling (NMS). Doctors with similar training are represented with the same symbol: local doctors with *triangles*, self-trained locals with *diamonds*, and the monk with a *cross*. Only axis one was significant, suggesting the coherent nature of local Tibetan medicine

Non-metric Multidimensional Scaling (NMS) of Tibetan doctors' plant lists reveal which doctors were more similar in their opinions (Fig. 4; only Axis 1 was significant ($P = 0.0196$), with a final stress of 18.475). Doctors who were trained similarly held similar opinions on most useful plants and were thus close to each other on the ordination. Whole plants and roots are the plant parts most commonly used by these doctors (Fig. 5a; $\chi^2 = 195.8$, df = 9, $P < 0.0001$). Infection, digestion, and circulatory problems are the most commonly treated ailments with these plants (Fig. 5b; $\chi^2 = 189.3$, df = 16, $P < 0.0001$). These medicinal plants are most often found between 2,900 m and 3,500 m (Fig. 6; $\chi^2 = 28.5$, df = 5, $P < 0.0001$).

Discussion

Botanists and Tibetan doctors have very different perspectives, priorities, and ratings for conservation of threatened useful plants. When asked to list

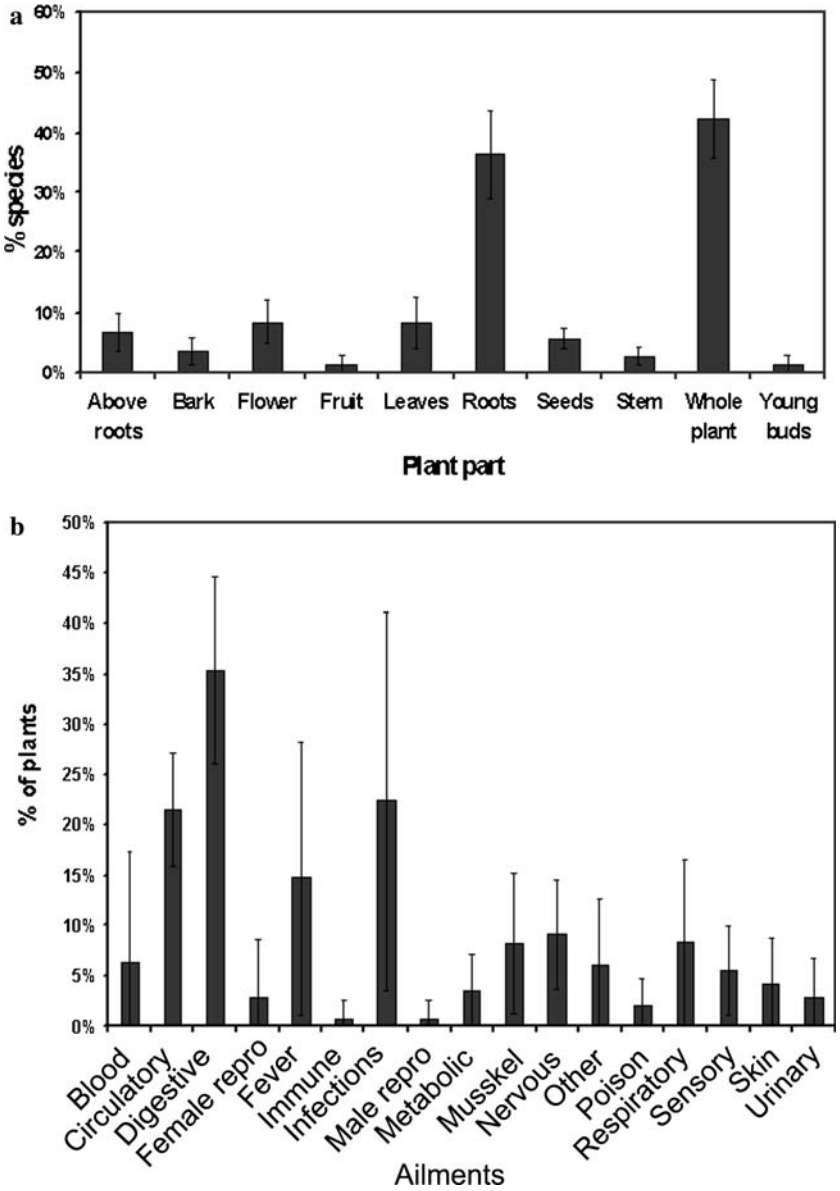

Fig. 5 Characteristics of Tibetan doctors' 20 most useful plants and fungi. (**a**) Plant parts used by the Tibetan doctors (mean frequencies ± SE). Whole plants and roots are most commonly used for medicines ($\chi^2 = 195.8$, df = 9, $P < 0.0001$). (**b**) Ailments treated (mean frequencies ± SE). Infections and digestive and circulatory problems are the most commonly treated ailments ($\chi^2 = 189.3$, df = 16, $P < 0.0001$)

threatened useful plants, botanists consider plant threat first and foremost, and medicinal and horticultural uses second; for Tibetan doctors, medicinal use is primary, followed by a more moderate view of plant threat. These results are

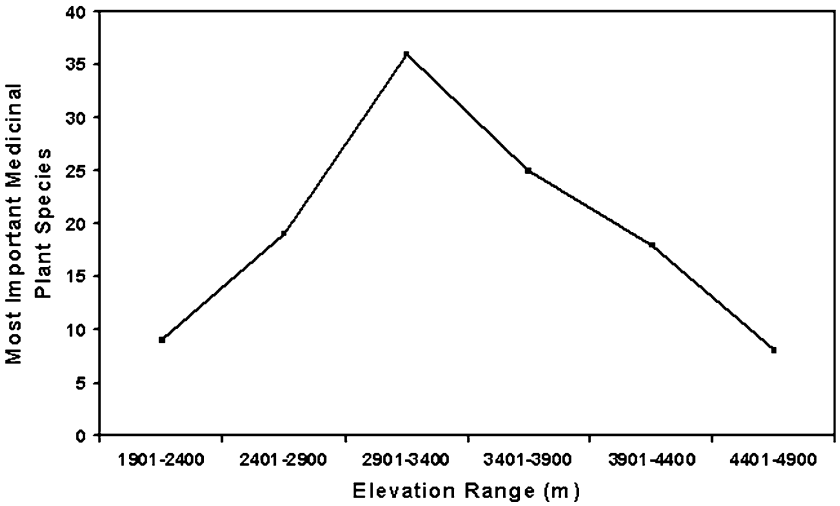

Fig. 6 Elevational distributions of the most useful plants and fungi as reported by the Tibetan doctors. Most of these plants and fungi are found at approximately 3,000 m (χ^2=28.5, df = 5, $P < 0.0001$), the elevation that the doctors inhabit

most likely explained if we consider that botanists want to make sure that plants and fungi are conserved above all, while doctors primarily want to assure that plants and fungi are available for use. Doctors are in favor of regulating commercial collection but want to avoid restricting their own careful harvest of a limited amount of their valuable medicines. This is in response to the growing popularity of traditional medicines, which has caused a shift of sustainable, low level harvesting to a more intense, commercially driven style of collection by plant harvesters. The extreme differences in species identified for conservation (only 4 plants in common) between botanists and Tibetan doctors reflect these different perspectives.

Additionally, there is a difference in geographic scale of evaluation: the botanists assessed plants and fungi threatened at a regional scale, while Tibetan doctors evaluated at a local scale. Some plants and fungi, threatened on a regional scale, may have a refuge near Khawa Karpo, since the *Menri*, Medicine Mountains, have been recognized for centuries for their wealth of medicinal plants.

Most of the threatened medicinal plants that were agreed upon by doctors and botanists are commonly collected for commercial sale. This highlights the pressure imposed by the booming trade in Tibetan medicines both within China and internationally (Olsen and Larsen 2003; Olsen and Bhattarai 2005; Law and Salick 2005). Traditional Tibetan doctors, like those interviewed in this study, observe traditional techniques for harvesting a small amount of herbs needed for their medical practices; however, lack of traditional constraints on rampant collectors serving export markets threaten populations of valuable medicinal herbs (Xu and Wilkes 2004). Conservation of medicinal plants is of the highest priority.

Among Tibetan doctors, views on medicinal plants and conservation varied; doctors similarly trained tended to share the same opinions on which plants and

fungi they consider the most valuable. Nonetheless, it is interesting to note that these education systems do not differ greatly from each other, suggesting that local Tibetan medicine has a coherent base. However, medicinal plants vary significantly on a broader scale (Salick et al. 2006), for example only 16 of the 78 plants from this study appear in Kletter and Kriechbaum (2001), which concentrates on Lhasa based Tibetan medicines.

While the opinions of botanists and Tibetan doctors are different, they are both real assessments and both sets of opinions are extremely important in determining conservation needs in this area. These differences indicate the need to integrate both TK and scientific knowledge in conservation of rare plants and fungi. Tibetan doctors may be told they must protect a certain plant species that the botanist have deemed as threatened in other areas but that locally is abundant. If doctors feel these claims are invalid or are unjustified, without consultation and education about the situation, they may disregard the botanists' concerns, warnings, and recommendations. Reciprocally, botanists unfamiliar with the basis of local perceptions may not appreciate local opinions which come from doctors who are familiar with the ecosystems they inhabit. Unified strategies for the management of resources like medicinal plants must be sought. The lack of attention to the overexploitation of plants and animals in several Tibetan regions will threaten the ecology and livelihood of communities (Cardi 2005). Without careful integration into local community perceptions and practices, conservation guidelines may be resisted if they are not in the interest of the people that use the land. Conservation priorities need to take into account perspectives of both TK and science. Perspectives of TK should be carefully considered on a local basis, since priorities can vary depending on areas. Collaboration can provides awareness of the regional scale for local people, and awareness of local conditions for conservationists and botanists. Collaborative efforts such as these can result in exceptionally informative accounts (e.g., Lama et al. 2001).

Furthermore comparisons of TK and science can help identify species that are especially in need of more detailed research. We are concentrating research on *Saussurea laniceps* (snow lotus) based on the joint recommendations of Tibetan doctors and botanists. Snow lotus is over-collected and under great evolutionary pressure (Law and Salick 2005). Our population ecology studies are investigating sustainable harvesting strategies (Law et al. in preparation). With cooperation to identify threatened species like snow lotus, not only do we understand which organisms need to be studied, but we also generate local and conservation support for our efforts. As recommended by the World Conservation Union (1980), we promote joint efforts between conservation and traditional knowledge for Khawa Karpo—the warrior god, sacred mountain, and biodiversity hotspot.

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Appendix

Appendix 1 List of threatened, useful plants and fungi produced by botanists and Tibetan doctors with descriptions of use categories and threat values. Mode was used for threat values of plants given by more than one Tibetan doctor

Botanists	Plant	Use categories	Threat value (Mode)
1	*Arisaema lobatum* Engl.	M-11, 13	3
2	*Corydalis bimaculata* C.Y. Wu & T.Y. Shu	M-3	3
3	*Cymbidium hookerianum* Rchb.f	O	3
4	*Cymbidium lianpan* T. Tang & F.T. Wang ex Y.S. Wu	O	3
5	*Fritillaria cirrhosa* D. Don	M-8, 9	3
6	*Fritillaria delavayi* Franch.	M-8, 9	3
7	*Lilium souliei* Franch.	M-8, 9	3
8	*Meconopsis horridula* Hook.f. & Thomson	M-7	3
9	*Meconopsis impedita* Prain	M-7	3
10	*Meconopsis lancifolia* Franch. ex Prain	M-7	3
11	*Megacodon stylophorus* (C.B. Clarke) Harry Sm.	M-5	3
12	*Paeonia delavayi* Franch. *var. lutea* (Delavay ex Franch.) S.G. Haw	M-15	3
13	*Pegaeophyton scapiflorum* (Hook.f. & Thomson) C. Marquand & Airy Shaw	M-9	3
14	*Saussurea gossypiphora* Wall.	M-1, 4, 9	3
15	*Saussurea laniceps* Hand.-Mazz.	M-1, 4, 9	3
16	*Saussurea medusa* Maxim.	M-1, 4, 9	3
17	*Soroseris rosularis* (Diels) Stebbins	M-1, 4, 9	3
Tibtean doctors			
1	*Cordyceps sinensis*	M-12	3
2	*Fritillaria cirrhosa* D. Don	M-12	3
3	*Aconitum tanguticum* (Maxim.) Stapf	M-11, 12	3
4	*Lagotis alutacea* W.W. Sm.	M-1, 9	3
5	*Pegaeophyton scapiflorum* (Hook.f. & Thomson) C. Marquand & Airy Shaw	M-7	3
6	*Pedicularis longiflora* Rudolph	M-3, 7	2
7	*Gentiana* sp. 1	M-3, 9	2
8	*Dracocephalum bullatum* Forrest ex Diels	M-10	2
9	*Gentiana urnula* Harry Sm.	M-1, 3, 6, 13	3
10	*Aconitum richardsonianum* Lauener	M-8	3
11	*Pedicularis przewalskii* Maxim.	M-3, 14	2
12	*Dracocephalum tanguticum* Maxim.	M-7, 10	2
13	*Rheum officinale* Baill.	M-1, 3	1
14	*Gymnadenia orchidis* Lindl.	M-7	1
15	*Corydalis* sp. 1	M-3, 10, 11	1
16	*Plantago depressa* Willd.	M-2, 14	1
17	*Swertia* sp. 1	M-3	1
18	*Acorus calamus* L.	M-10	3
19	*Lagotis* sp. 1	M-3, 6, 10	3
20	*Punica granatum* L.	M-3, 7	1
21	*Rhododendron* sp. 1	M-1, 4	1
22	*Sinolimprichtia* sp. 1	M-4	3
23	*Pterocephalus hookeri* (C.B. Clarke) L. Diels	M-3	2

Appendix 1 continued

Botanists	Plant	Use categories	Threat value (Mode)
24	*Phlomis* sp. 1	M-9, 13	1
25	*Inula racemosa* Hook.f.	M-3	3
26	*Crocus sativus* L.	M-1, 7	3
27	*Oxytropis reniformis* P.C. Li	M-8	1
28	*Pyrus pashia* Buch.-Ham. Ex D. Don	M-4	1
29	*Herpetospermum* sp. 1	M-3	1
30	*Gentiana* sp. 2	M-9	2
31	*Gentiana straminea* Maxim.	M-11, 13	3
32	*Saxifraga* sp. 1	M-3, 8	1
33	*Vladimiria souliei* (Franch.) Ling	M-3, 12	3
34	*Incarvillea compacta* Maxim.	M-8, 10	3
35	*Corydalis* sp. 2	M-3, 10	2
36	*Chrysosplenium carnosum* Hook.f. & Thomson	M-3, 10	2
37	*Phlomis younghushandii* Mukerjee	M-4	2
38	*Rhodiola crenulata* (Hook.f. & Thomson) H. Ohba	M-1	2
39	*Primula secundiflora* Franch.	M-1	1
40	*Meconopsis horridula* Hook.f. & Thomson	M-3, 14	2
41	*Gastrodia elata* Blume	M-1	3
42	*Gynura japonica* (Thunb.) Juel	M-10	3
43	*Panax japonicus* var. *major* (Burkill) C.Y. Wu & Feng	M-11, 12	3
44	*Coptis* sp.	M-3, 6	1
45	*Plantago asiatica* L.	M-5	1
46	*Verbena officinalis* L.	M-5	1
47	*Stephania delavayi* Diels	M-8	1
48	*Ainsliaea pertyoides* Franch.	M-7, 14	1
49	*Fritillaria delavayi* Franch.	M-1, 10	3
50	*Mahonia mairei* Takeda	M-3	1
51	*Aconitum vilmorinianum* Kom.	M-10	2
52	*Elaeagnus viridis* Serv.	M-3	2
53	*Dioscorea cirrhosa* Lour.	M-3	1
54	*Arisaema consanguineum* Schott	M-10	2
55	*Angelica sinensis* (Oliv.) Diels	M-10	3
56	*Saussurea laniceps* Hand.-Mazz.	M-10	3
57	*Corydalis yanhusuo* W.T. Wang	M-3, 9	2
58	*Hypecoum leptocarpum* Hook.f. & Thomson	M-3, 9	2
59	*Saxifraga* sp. 2	M-3	2
60	*Aconitum* sp.	M-7, 14	1
61	*Lagotis yunnanensis* W.W. Sm.	M-1	2
62	*Meconopsis torquata* Prain	M-7, 9, 14	3
63	*Galium* sp.	M-1, 9	2
64	*Aristolochia griffithii* Hook.f. & Thomson ex Duch.	M-3	1
65	*Delphinium* sp.	M-7	1
66	*Primula* sp.	M-10	1
67	*Pedicularis trichoglossa* Hook.f.	M-3	2
68	*Adhatoda vasica* Nees	M-1	2
69	*Sisymbrium heteromallum* C.A. Mey	M-3	1
70	*Halenia elliptica* D. Don/*Gentianopsis grandis* (Harry Sm.) Ma	M-3, 6	1

Appendix 1 continued

Botanists	Plant	Use categories	Threat value (Mode)
71	*Rhodiola* sp. 1	M-1, 3	1
72	*Lancea tibetica* Hook.f. & Thomson	M-3, 8	1
73	*Fragaria orientalis* Losinsk.	M-1, 14	2
74	*Nardostachys grandiflora* DC.	M-6, 9	3
75	*Polygonum* sp.	M-1	1
76	*Gentiana stipitata* Edgew. subsp.*tizuensis* (Franch.) T.N. Ho	M-1, 3, 6	2
77	*Taraxacum tibetanum* Hand.-Mazz.	M-4	2
78	*Thlaspi arvense* L.	M-7	1

Use categories include: O, Ornamental; M, Medicine. Subcategories for medicine: 1, Blood & circulatory system; 2, Dental; 3, Digestive system; 4, Reproduction & sexual health; 5, Urinary System; 6, Immune system; 7, Muscular–skeletal system; 8, Nervous system & mental health; 9, Respiratory system; 10, Sensory system; 11, Skin & related tissue; 12, Infections; 13, Poison; 14, Non-Western medical systems; 15, Belief systems

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