植 物 分 类 学 报 44 (6): 721–732(2006) doi:10.1360/aps060080
Acta Phytotaxonomica Sinica http://www.plantsystematics.com

Resolving place names in Amdo and Kham: A gazetteer for the Hengduan Mountains region of Southwest China*

Susan L. KELLEY**

(*Arnold Arboretum and Harvard University Herbaria*, 22 Divinity Avenue, Cambridge, MA 02138-2020, U.S.A.)

Abstract Perhaps no region on earth presents such a confusing array of place names as does the area made up of the former provinces of Kham and Amdo in historic Tibet (Xizang). Within these areas, cities, towns, villages, mountains, lakes and other geographic features have at least two names applied to them, one Tibetan, the other Chinese. Overlying this indigenous nomenclature are the names applied by outsiders, mostly Europeans, each of whom used their native language to transliterate the names they heard or read from Tibetan or Chinese script, and names in the languages of other ethnic minorities who live within the area. Adding to the confusion are the conflicting "standards" for transliterating Tibetan and Chinese names. To resolve the inconsistencies and uncertainties of place names in this region, a multilingual gazetteer and thesaurus was prepared. The gazetteer-thesaurus was compiled to be used as a tool for correlating the often radically different names assigned to a single place or feature and to provide the geographic coordinates for each. The impetus for this project was the need to assign geographic coordinates to plant specimens collected in the area since the latter part of the 19th century up until the advent and widespread use of Global Positioning System (GPS) receivers in the 1990s. Georeferencing specimens is necessary for plotting the historical distribution of species and for more completely understanding the information contained on specimen labels. Knowing the distribution of plants is important for answering phylogenetic questions, determining local and widespread biogeographical patterns, identifying areas of unusually high diversity or endemism, and determining areas in need of special protection. The value of such a gazetteer, however, extends well beyond the field of botany. It is intended to be of use to anyone with a desire to know the nomenclatural history of places in the area and for pinpointing with a fair degree of accuracy the location of each of those places.

Key words Tibet (Xizang), Amdo, Kham, Hengduan Mountains, gazetteer, biodiversity, Geographic Information Systems (GIS), herbarium, conservation, georeferencing.

Perhaps no region on earth presents such a confusing array of place names as does the area made up of the former Tibetan provinces of Kham and Amdo. These two places themselves have been subsumed into parts of the present day Chinese provinces of Gansu, Qinghai, Yunnan and Sichuan, and part of Kham was briefly included in the former short-lived Chinese province of Sikang in the mid 20th century. Within what was Amdo and Kham, cities, towns, villages, mountains, lakes and other geographic features have at least two, often quite different, names applied to them, one Tibetan, the other Chinese. Overlying the indigenous nomenclature are the names applied by outsiders, mostly Europeans, who used their native language to transliterate the names they heard, plus names in the languages of other ethnic minorities who live within the area. Adding to the confusion are the conflicting

Received: 9 May 2006 Accepted: 26 June 2006
Supported by the U. S. National Science Foundation, Grant No. DEB-0321846, and the National Natural Science Foundation of China, Grant No. 40332021.

* The gazetteer-thesaurus will be available early in 2007 on the Hengduan Mountains project website (http://maen. huh.harvard. edu:8080/china).

** E-mail: < skelley@oeb.harvard.edu >.

"standards" for transliterating Tibetan script and Chinese characters into Western languages: Wade-Giles, Lessing-Othmer, the French system (Bulletin de ΓEcole Française d'Extreme Orient), the Chinese Postal System, *Hanyu Pinyin*, and numerous others—and these are just for Romanizations.

To resolve the confusion of place names in this former Tibetan region, a multilingual gazetteer and thesaurus was prepared. The gazetteer-thesaurus was compiled to be used as a tool for correlating the often radically different names assigned to a single place or feature and to provide the geographic coordinates for each. The impetus for this project was the need to assign geographic coordinates to plant specimens collected in the region and housed in the Harvard University Herbaria (primarily A, AMES, FH, and GH—acronyms from Holmgren & Holmgren, 1998). The specimens date primarily from the 19th through the late 20th centuries. Geographic information on the labels from that period rarely includes more than the name of the place where the specimen was collected, and frequently includes the elevation. A few specimens, primarily those of George Forrest, a Scottish botanist who focused his attention on the narrow strip of land between the Nu Jiang (Salween) and Lancang Jiang (Mekong) rivers, include the latitude of the place of collection. Until the advent and widespread use of the Global Positioning System (GPS) and the availability of inexpensive GPS handheld receivers in the 1990s, the inclusion of geographic coordinates on botanical specimens was rare.

To know the distribution of a species of plants it is first necessary to georeference the collections so they can be plotted on a map. Knowing the distribution of the plants in an area can tell us much about such things as endemism, phylogenetics and local and widespread biogeographical patterns, and can pinpoint local areas of particularly high diversity and/or endemism, which in turn can be used for determining areas in need of special protection.

1 Specimen collections

Herbarium collections hold valuable information for studying species diversity (Meier & Dikow, 2004), conservation biology (Soberón et al., 2000), taxonomy (Schatz, 2002; Masson et al., 2001), systematics, biodiversity (Ponder et al., 2001; Neufeld et al., 2003; Ball, 2005), species richness (Petersen et al., 2003), biogeography (Kreft, 2004), floristics (Barkley, 2000; Ertter, 2000), and phytosociology (Kürschner et al., 2005). The majority of these collections, however, remain "locked up" in cabinets and cases and are accessible only to on-site researchers, to those with sufficient resources to make extended visits to study them in person, or through an established inter-herbarium loan system. Fortunately, in the past decade, portions of a number of collections have been made available electronically; the New York Botanical Garden (NYBG: http://www.nybg.org/bsci/vh/), the Linnaean Herbarium in Stockholm (S_LINN: http://linnaeus.nrm.se/botany/fbo/welcome.html.en), the herbarium of the Royal Botanic Garden, Edinburgh (RBGE: http://rbg-web2.rbge.org.uk/vherb/vherb2. php), the Harvard University Herbaria (A, AMES, ECON, FH, GH: http://www.huh.harvard.edu/), the Missouri Botanical Garden (MO: http://mobot.mobot.org/W3T/Search/spdp.html), the Smithsonian Institution (US: http://ravenel.si.edu/botany/types/), and others. Additionally, large biological data sets across multiple institutions and sophisticated digital tools for capturing specimen data are now available (GBIF, MaNIS, BioGeomancer). Yet despite the increase in online collection information, researchers are still left with locality data that are to a large extent unusable for meaningful analyses (Wieczorek et al., 2004). Until a large percentage of specimens that lack geographic coordinates are georeferenced, their full potential cannot be realized (Krishtalka & Humphrey, 2000; Causey et al., 2004; Gippoliti, 2005). Georeferencing, however, is not trivial. Specimen locality data can be incomplete, vague, or not in the language, or even script, of the researcher; place names can change as

political boundaries are altered; multiple localities can have the same name; or, villages or towns may no longer exist.

Biogeographically, the area of interest to us is known as the Hengduan Mountains Hotspot of Biodiversity (Boufford & Van Dijk, 1999; Boufford et al., 2004). The Hengduan Mountains region (Fig. 1) lies at the eastern edge of the Qinghai-Tibetan Plateau, largely in what were the former Tibetan provinces of Kham and Amdo, and in western Sichuan and northern Yunnan. The Hengduan Mountains region is noteworthy for being one of the earth's 34 "Hotspots of Biodiversity" (Mittermeier et al., 1999, 2004). The basis for creating a gazetteer-thesaurus of place names relevant to the Hengduan Mountains region of southwest China are the extensive collections of the Harvard University Herbaria. At the time of writing, more than 50000 historic and contemporary specimens collected from this highly diverse region had been bar-coded and the data from their labels entered into the Herbaria's database. Place names have been gleaned from the database for the gazetteer. Each name is pinpointed on a map, using both historic and modern maps, and the coordinates are determined. The gazetteer is then used to assign geographic coordinates to the specimens. To date, more than 20000 of these specimens have been georeferenced.

As is typical of many natural history collections, the quality of data on labels of the specimens varies widely, ranging from only the collector's name and country of collection, to more detailed information about locality, habitat, geology and features of the living plant. Often, the locality data are only textual, and the Chinese and Tibetan names, as well as the myriad ethnic dialects common to the region, varies widely. What most of the older specimens have in common is the lack of geographic coordinates. The gazetteer-thesaurus contains approximately 3000 toponyms, which have been gathered from historic and contemporary specimen label data, data layers from Environmental Systems Research Institute's (ESRI) Digital Map Database of China (DMDC), collectors' journals and maps, the Alexandria Digital Library Gazetteer, and a variety of Harvard University library resources. Chinese characters (*hanzi*), which are today the only truly accurate names for each of the places, are associated with many of the names. Tibetan script and Wylie transliterations will be added as the project progresses. The gazetteer-thesaurus will be available early in 2007 on the Hengduan Mountains project website (http://maen.huh.harvard.edu:8080/china). Although we will use it specifically for botanical collections, the gazetteer-thesaurus is intended to be a resource, across a variety of disciplines, for international researchers, students, scholars, museum curators, government agencies and conservation organizations.

The geographic data from these collections will be used to address questions related to species richness and diversity in an area, temporal and spatial patterns of distribution of specific taxa, broad biogeographical patterns, ecological processes at work in the region and areas that have been over- or under-collected. Exploration of the region has not been confined to botanists, but it has also been of interest to geographers, geologists, zoologists, climatologists, anthropologist, paleontologists, historians, etc. The great Western explorers of the Victorian "Age of Exploration" were drawn to what was considered to be one of the last undiscovered places on earth, and exploration continued throughout the 20th century, although it was interrupted at times by the political turmoil in the region. Until the late 20th century, large portions of the area were still closed to outsiders. The relaxing of restrictions in recent years has made it possible to resume documentation of the natural resources in this highly diverse region. The current economic boom in China, the many infrastructure development projects, and the growth in the tourist industry, especially in the western provinces and the Tibet Autonomous Region (Xizang Autonomous Region, in Chinese "Xizang Zizhiqu" and usually as "Xizang"), are exerting extreme pressures on the natural resources and on the very survival of the indigenous cultures there. Recognizing the uniqueness

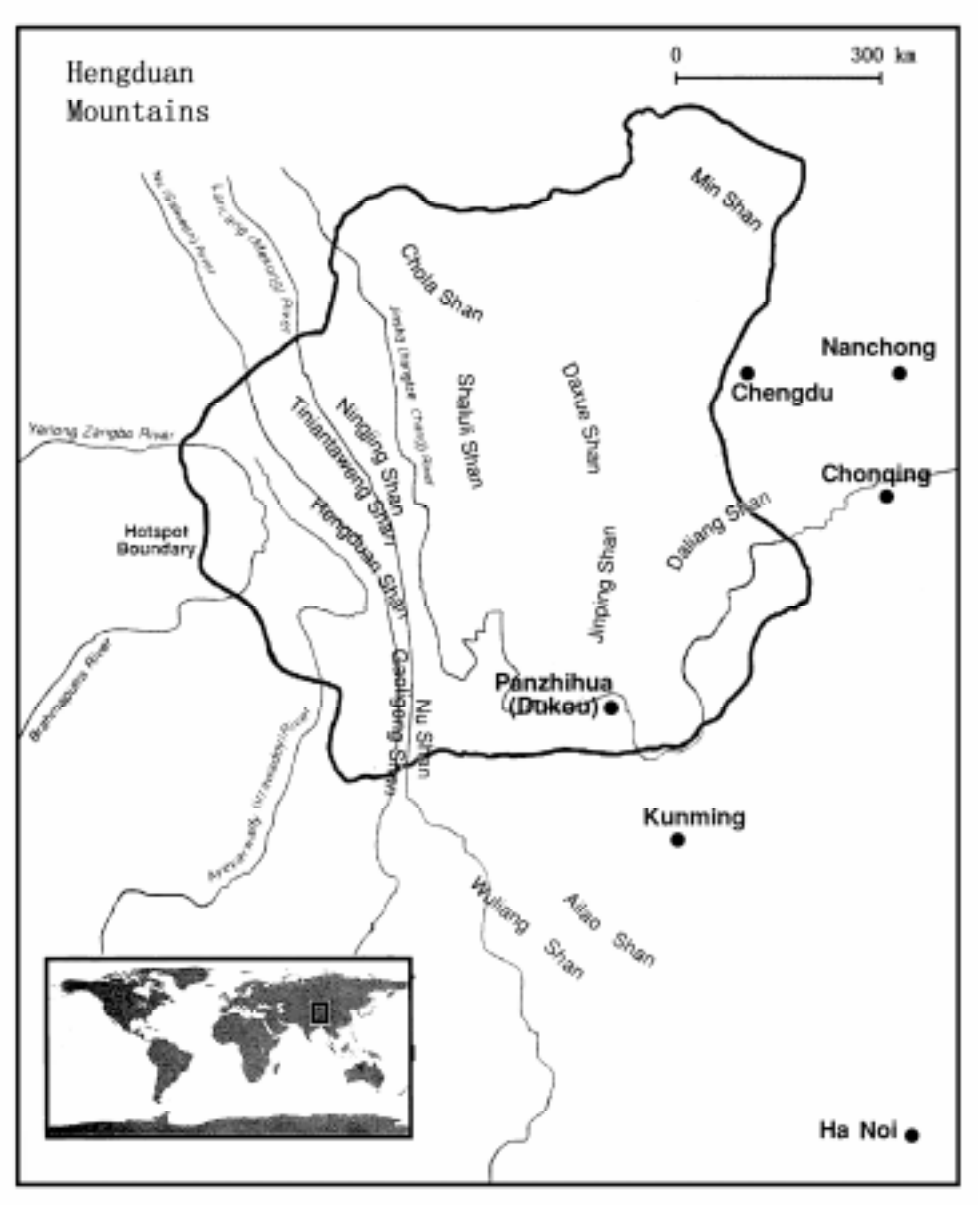

Fig. 1. Map of the Hengduan Mountain hotspot region.

of this hotspot region, the Chinese government is working with scientists and international conservation organizations, such as The Nature Conservancy, Conservation International, and World Wildlife Fund, to establish nature preserves and to create innovative means to involve the indigenous populations and enhance the local economies. Natural history specimens are a source of historical and current data on the biodiversity in this region. By using the spatio-temporal data stored on the labels of herbarium specimens, and other natural history collections, these groups can make more informed decisions as to how to protect and conserve

the biological diversity of this area.

2 A biodiversity "hotspot"

The Hengduan Mountains region has been designated one of the world's 34 biodiversity "hotspot" regions (Myers, 1988; Mittermeier et al., 2004), of which it is one of only four in the North Temperate Zone. With an area of approximately 500000 km^2 (roughly the size of Texas, USA), the region is home to 10000–11000 species of vascular plants, or about one third of the vascular plants in China. Approximately 29 percent of them are endemic. The high plant diversity is unusual for a north temperate region and is comparable to some parts of the tropics. The Borneo Lowland Rain Forest in Kalimantan, Indonesia, for instance, has an area of about 427500 km^2 and contains approximately 10000 species of plants (http://www.nationalgeographic.com/wildworld/profiles/terrestrial/im/im0102.html).

The Hengduan Mountains hotspot area contains at least 25 percent of the world's species of *Rhododendron* L., *Delphinium* L., *Primula* L., *Gentiana* L., *Saussurea* DC., *Corydalis* Vent., and *Anaphalis* DC., and over one half of the world's species of *Ligularia* Cass., *Cremanthodium* Benth., *Cotoneaster* Medik. and *Pedicularis* L. Additionally, there may be as many as fifty species of endemic mosses. The diversity in many plant groups drops sharply to the west of the region. Table 1 compares the number of species of selected, speciose genera in the Hengduan Mountains region with Nepal (ca. 500 km to the west) and with Japan (ca. 3000 km to the east), another of the world's hotspots of biodiversity (Boufford et al., 2004). Mammalian diversity is also high in the Hengduan Mountains region, with the Giant panda being the most famous of the more than 230 species. Additionally, there are 611 species of birds, 94 species of reptiles and 98 species of amphibians (Mittermeier et al., 2004).

Table 1 Comparison of the numbers of species of selected genera in the Hengduan Mountains, Nepal and Japan

Genus	Hengduan Mts.	Nepal	Japan
Rhododendron L.	225	32	51
Pedicularis L.	216	63	15
Gentiana L.	117	43	15
Primula L.	113	59	14
Saussurea DC.	101	34	25
Ligularia Cass.	70	5	8
Cremanthodium Benth.	38	13	0
Anaphalis DC.	33	17	3
Leontopodium R. Br.	25	8	8
Saxifraga L.	136	77	16
Aconitum L.	104	31	~30
Salix L.	103	30	38
Corydalis Vent.	85	32	13
Delphinium L.	71	20	0
Sedum L.	61	16	18
Arenaria L.	57	19	3
Silene L.	48	24	3
Thalictrum L.	36	20	15
Totals	1639	543	275

The extreme topography of the region is defined by three of the major rivers of eastern Asia, Nu Jiang (Salween), Lancang Jiang (Mekong) and Jinsha Jiang (the upper reaches of the

Yangtze), which flow as close as 80 km to each other through spectacular gorges between the north-south trending mountains. After originating on the Qinghai-Tibetan Plateau, these rivers traverse several countries and serve to water approximately one quarter of the world's population. Steep gorges and high peaks characterize the Hengduan Mountains region, with elevations ranging from less than 2000 m in some valleys to over 7550 m at Gongga Shan, the highest mountain in Sichuan. The average elevation is over 4000 m with precipitous drops of 1000 to 2000 m to the valley floor not uncommon.

The area is home to more than twenty ethnic minorities, including Tibetan, Bai, Yi, and Naxi. For thousands of years, these cultures have been stewards of the land and dependent upon its resources for their livelihoods. Many of the region's mountains, lakes, passes and other natural features are sacred within some of these cultures, and many of the plants and fungi are important in traditional medicine.

The high percentage of endemic species in this north temperate, high alpine region, coupled with the threat of destruction by increasing anthropogenic forces, makes it mandatory that as much useful information on its natural resources be made available in a useable form as rapidly as possible. Detailed and widespread knowledge of the area is key to ensuring the preservation of the vast and unique biological resources there.

3 Exploration in the region

The Hengduan Mountains hotspot lies at the eastern edge of the Qinghai-Tibetan Plateau, and extends from the Sichuan Basin to eastern Xizang (Tibet) and northernmost Myanmar (Burma) and from southern Gansu southward to the Yunnan plateau. Most of the region lies in what were once the Tibetan provinces of Amdo and Kham. After 1951 the three provinces of historic Tibet, Amdo, Kham and Ü-tsang, were subsumed into the Chinese provinces of Yunnan, Sichuan, Qinghai, Gansu, and the newly formed Xizang Zizhiqu (Tibet Autonomous Region). With its unique physical features, vast natural resources and mysterious, romantic aura, Tibet has long held an attraction for Westerners; but because the terrain is rugged, the weather extreme, and its borders once carefully guarded by the Dalai Lama's protectors, it has remained largely inaccessible.

As early as the 13th century a few Westerner managed to penetrate the region under a variety of guises and for a variety of reasons. Marco Polo briefly ventured into eastern Tibet and western Yunnan (http://www.newadvent.org/cathen/12217a.htm) during his 24 year journey. In the 17th century, Catholic and Protestant missionaries began to establish missions in western China and made attempts to cross into Tibet (Stockwell, 2003). In addition to spreading the Gospel and saving souls, many of these men were also scientists and explorers. The Jesuits, John Grueber and Albert d'Orville traveled from Beijing to Lhasa in 1661, and used their training as geographers to survey the western borderlands of China (Kircher, 1667). In the 1840's, French missionaries Évariste Régis Huc and Joseph Gabet were expelled from Lhasa after demonstrating a microscope in the Potala Palace. The detailed observations of the people and geography of eastern Tibet that they made on their journey back to eastern China were invaluable to subsequent explorers in the region (Huc & Gabet, 1928).

The Chinese botanical collections made by two French missionaries, Père Armand David and Père Jean-Marie Delavay, are well-known. David spent several years in the 1860's collecting natural history specimens in China, much of that time in eastern Tibet around Mupin (Baoxing) and western Sichuan. In addition to discovering more than 1500 species of plants unknown to science, David collected many zoological specimens, some of which had also never been described scientifically (Bretschneider, 1898). He was the first Westerner to see a Giant panda (*Ailuropoda melanoleuca*) and had the skin of one, along with many other

zoological and botanical specimens, sent back to the Muséum d'Histoire Naturelle in Paris. The Giant panda is now the best known rare mammal species from the Hengduan Mountains region. Père Delavay was assigned to a mission in NW Yunnan in the 1880's and collected plants for almost ten years in the mountains around Dali. Among his 200000 plant specimens, representing over 4000 species, were many new discoveries.

The late 19th and early 20th centuries, once thought of as the last great "Age of Exploration" (Donoghue & Alverson, 2000), saw the influx of many scientists, explorers, and adventurers to the rugged, hard-to-access regions of eastern Tibet. The Royal Geographic Societies of London, Paris, and Russia, the Natural History Museum in New York and the Field Museum in Chicago each sponsored expeditions and published accounts of the explorers' travels and discoveries. Britain and France attempted to expand their colonial interests into the region and to extend trade routes through Tibet. The British East India Company sponsored expeditions into Tibet through India, Burma, and eastern China (Gill, 1880), while France sought new trade routes from Tonkin (part of modern Viet Nam) into Yunnan (Bonvalot, 1891; Little, 1910). In 1899, the Russian Geographic Society sponsored P. K. Kozloff on a two-year expedition to Turkestan and eastern Tibet. Kozloff and his team collected 30000 sheets of herbarium specimens in addition to specimens of birds, butterflies, insects, fish, and mammals (Kozloff, 1902, 1908a, b, c).

Geologists also came to study this eastern end of the great Himalayan mountain range (Legendre, 1916; Gregory & Gregory, 1923), and ethnographers came to study the many ethnic groups of the region (e.g., Bacot, 1913). Wealthy Western gentleman hunters and explorers came for sport and to capture treasures for their sponsors. Even Theodore Roosevelt's sons, Teddy, Jr. and Kermit, traveled to the eastern edge of Kham to obtain the first Giant panda specimen for North America (Roosevelt & Roosevelt, 1929; Stevens, 1934). Paleontologist Roy Chapman Andrews, Director of the American Natural History Museum for six years and most famous as the discoverer of the first dinosaur eggs in Mongolia, made valuable collections near Lake Erhai in NW Yunnan. His team collected 1300 mammals and several hundred bird specimens and photographed much of the region between Dali, Zhongdian and the Lancang Jiang (Mekong River) (Andrews & Andrews, 1918).

Intrepid Victorian female explorers also traversed the high, rugged mountains of eastern Tibet intent on reaching Lhasa. Some returned home to write books and articles documenting the people and the sights they encountered. Isabella Bird Bishop, who was the first female to be admitted into the Royal Geographic Society (Miller, 2000), spent five months in the unexplored mountains of northwestern Sichuan and followed the Min Jiang River to its source (Bishop, 1897). Alexandra David-Néel, a Buddhist scholar who traveled widely in India, Nepal and China from 1917 to 1946, was the first European woman to enter Lhasa. For six months at the end of 1923 and the beginning of 1924, she traveled through southeastern Tibet and up the Lancang Jiang and Nu Jiang river valleys (Désiré-Marchand, 1996). Her maps and accounts of her travels provide an invaluable insight into the land and its people.

At first, botanical explorers came primarily from Britain, France, Austria, Germany, the United States and Sweden. In addition to Delavay, mentioned earlier, Frank Kingdon-Ward, George Forrest, Camillo Schneider, H. Handel-Mazzetti, E. H. Wilson, Frank Ludlow and George Sherriff, Karl August Harald Smith (Harry Smith), Augustin Henry, J. A. Soulié, E. E. Maire and Joseph Rock each made significant collections in the Hengduan Mountains region. Chinese botanists soon followed, and made further important collections in this region. In the 1930s and 1940s, C. W. Wang, T. T. Yü, H. T. Tsai, R. C. Ching, K. M. Feng, C. Wang, W. P. Fang, and others, were paid by the Arnold Arboretum of Harvard University to collect specimens in southwest China. Joseph Rock, Camillo Schneider, H. Handel-Mazzetti and E. H. Wilson were also in the employ of the Arboretum. Their collections, together with those of

the Chinese, make up a significant portion of the Harvard University Herbaria's holdings of temperate Asian plants.

4 Resources for the gazetteer

Many explorers to eastern Tibet and the western borderlands of China documented their travels and discoveries in journal articles and books, and these were often accompanied by maps. Geographic names on the maps were also used on specimen labels. In our gazetteer, the names gleaned from specimen label data are associated with current place names. ESRI's Digital Map Database of China (DMDC) was used as a base map for georeferencing. The ESRI data set (1:1000000) includes provincial and county boundary layers, over 33000 contemporary place names, roadways, hydrography, and hypsography. The Alexandria Digital Library Gazetteer and a dataset from Conservation International of place names in SW Sichuan were also used as sources of geographic names.

Some of the maps are particularly useful in associating historic and idiosyncratic place names with current localities. Joseph Rock, an Austrian botanist and ethnographer, spent 37 years making botanical and zoological collections in northwestern Yunnan, southern Sichuan and southeastern Tibet. The four maps that he provided in his two-volume *The Ancient Na-khi Kingdom of Southwest China* (1947) were georeferenced to the DMDC. Many of the over 1000 place names (Naxi, Tibetan, and Chinese) on his maps relate specifically to his and other botanists' collections. In these two volumes, Rock also makes reference to the place names that Heinrich Handel-Mazzetti used for his collections in the region from 1914 to 1918 (Handel-Mazzetti, 1927), and he also cites the place name variations used by Major H. R. Davies, a British officer stationed in Burma in the late 19th and early 20th centuries, on his map of Yunnan (Davies, 1909).

Rock was also in the employ of the National Geographic Society for a portion of his time in western China, and his articles and maps published in the National Geographic Magazine were an additional source of toponyms (Rock, 1930 a, b; 1931). Other resources for toponyms were the maps compiled by Gören Herner of the routes of the Swedish botanist Karl August Harald (Harry) Smith (Herner, 1988); two volumes published by the Royal Botanic Garden Edinburgh (Diels, 1912, 1924) that detail George Forrest's collections from southwest China; a map of NW Yunnan showing the route of the geologist J. W. Gregory (Gregory & Gregory, 1923); E. Teichman's map of eastern Tibet (Teichman, 1922); and the numerous maps that accompanied the accounts of other explorers in the region.

5 Challenges for creating the gazetteer

The problem of inaccurate, obscure, or even missing locality data can make it difficult to determine where a specimen was collected. Data from specimen labels are often lacking in detail, especially on labels associated with older collections. In some instances, collection locality is often noted only to province. The additional problem of encountering multiple locations with the same name, or a place that has undergone a change of name, confounds the problem.

Systematic Romanization of the Chinese language was begun by Jesuit priests who were sent to China in the early 17th century to preach Christianity. In 1815, the English priest, Robert Morrison, created a system that was the basis of the system developed in the mid-19th century by Thomas F. Wade, who was the Chinese language secretary in the British embassy to China. In 1912, H. A. Giles modified Wade's system. The Wade-Giles system was the one most widely used until 1979, when the International Standard Organization passed a resolution adopting *Hanyu Pinyin* as the international standard for Chinese. In the early 20th

century, the China Postal Atlas published another system. That system, which was based on the Wade-Giles system, was intended for standardizing place names on letters and stamps, but applied only to those places that had post offices.

The Postal Atlas and the Wade-Giles systems were sometimes used interchangeably on an individual map. Transliterations of Chinese characters on maps are often without the diacritical marks used in standardized systems of transliteration. Map makers from Western countries often combined different systems from a variety of maps, so that curious admixtures of English, German, French, Russian, and other forms were often used.

Determining place names from the Hengduan Mountains region is not simply a matter of deciphering Chinese. The region is home to a number of ethnic groups such as Hui, Bai, Naxi, Yi and others, and, because much of the region lies within the historic boundaries of Tibet, there is also a large Tibetan population. Transliterations of place names are often unique to a collector (as, for example, aural interpretations of the local pronunciation), and sometimes the same place is spelled differently on different occasions by an individual collector. For example, for the town of Benzilan, in NW Yunnan Province, Joseph Rock gave the names Pong-tse-ra and Pen-tzu-lan in his two-volume work, but on his labels for specimens collected there, he uses the names Ponzela or Pungtzera (Fig. 2). For these reasons, each place name can have multiple variations—from the local native populations, a variety of Romanized toponyms, and individual collector's idiosyncratic variants. Additionally, official government place names have changed as political boundaries have been altered over time. For instance, in 1939 Sikang (Xikang, Hsi-k'ang) became a province in western China. In 1955 the portion of Sikang east of the Jinsha Jiang was joined to Sichuan; the Tibet Autonomous Region received the remainder.

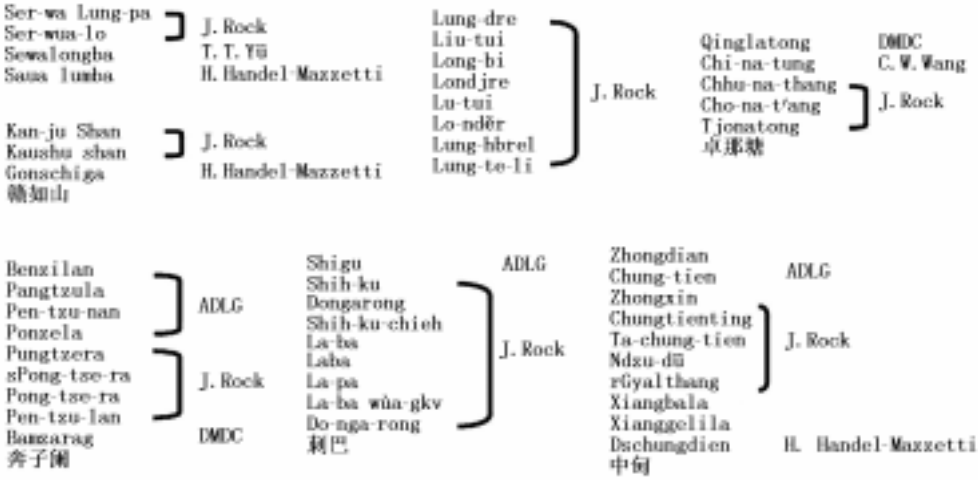

Fig. 2. Variation in romanization of place names in Kham. Data from various collectors and electronic resources. ADLG: Alexandria Digital Library Gazetteer; DMDC: Digital Map Database of China.

Although label data from more than 50000 specimens from the Hengduan Mountains region have been entered into the Harvard University Herbaria database, we suspect that more than 80000 specimens from the area remain to be entered. The gazetteer-thesaurus will continue to grow as additional locality data from these specimens are added, but it is unlikely

that the number will be large. Chinese characters (*hanzi*) are already associated with many of the names, and Tibetan script will be added as the project progresses.

6 Conclusion

Herbarium collections hold vast amounts of historical and current data about species richness, diversity, and distribution. The usefulness of collections, however, has been historically limited not only by their relative inaccessibility, but also by the lack of specific locality data that can be understood in terms of current world geography. Our multilingual, searchable gazetteer-thesaurus for the Hengduan Mountains region of southwest China provides place name variations gleaned from plant specimen labels, points to the currently recognized name, and provides the geographic coordinates for each locality. For our project, the gazetteer-thesaurus will be essential for mapping specimens, which in turn will help in determining the extent of the Hengduan Mountains region; revealing unexplored and under-explored, and even over-explored, areas and thus help to determine sites for future field work; elucidating temporal and spatial changes in the plant biodiversity of the region; identifying patterns of species richness and diversity, broad biogeographical patterns and evolutionary processes. Geographic data will provide the ability to map specimens using Geographic Information Systems (GIS), which may be a means of locating mini-hotspots within the overall area and may provide clues to the mechanisms behind species distributions and the high levels of diversity and endemism within the hotspot region. We believe this multilingual gazetteer-thesaurus will serve as a tool for "unlocking" valuable information in herbarium and other natural history collections from this extremely diverse and threatened "hotspot", and will be useful to a large multi-disciplinary audience.

Acknowledgements I would like to thank Dr. David BOUFFORD (Harvard University Herbaria & Arnold Arboretum) for his critical reading of the manuscript and DUAN Lihong (Arnold Arboretum) for her assistance in deciphering many of the place names included in the gazetteer. A portion of the information for the gazetteer was obtained through collaboration with colleagues in China made possible by support from the U.S. National Science Foundation (DEB-0321846) and the National Natural Science Foundation of China (NNSFC-40332021).

References

Andrews R C, Andrews Y B. 1918. Camps and trails in China. New York: C. Appleton & Co.

Bacot J. 1913. Les Mo-so; Ethnographie des Mo-so, leurs religions, leur langue et leur écriture. Leide: E J. Brill.

Ball M. 2005. Biodiversity Building Blocks. GeoWorld August 2005: 24–27.

Barkley T M. 2000. Floristic studies in contemporary botany. Madroño 47 (4): 253–258.

Bishop I. 1897. A Journey in Western Sze-Chuan. Geographical Journal 10 (1): 19–50.

Bonvalot G. 1891. Across Thibet.Vols. 1 & 2. London: Cassell & Co., Ltd.

Boufford D E, Van Dijk P P. 1999. South-Central China. In: Mittermeier R A, Myers N, Mittermeier C G eds. Hotspots: Earth's Biologically Richest and Most Endangered Terrestrial Ecoregions. Mexico City: CEMEX & Conservation International. 338–351.

Boufford D E, Van Dijk P P, Lu Z. 2004. Mountains of Southwest China. In: Mittermeier R A, Robles-Gil P, Hoffmann M, Pilgrim J D, Brooks T M, Mittermeier C G, Lamoreux J L, Fonseca G eds. Hotspots Revisited: Earth's Biologically Richest and Most Endangered Ecoregions. 2nd ed. Mexico City: CEMEX & Conservation International. 159–164.

Bretschneider E. 1898. History of European Botanical Discoveries in China. London: Sampson Low, Marston & Co.

Causey D, Janzen D H, Townsend P A, Vieglais D, Krishtalka L, Beach J H, Wiley E O. 2004. Museum collections and taxonomy. Science 305: 1106–1107.

Davies Major H R. 1909. Yün-nan, the Link Between India and the Yangtze. Taipei: Ch'eng Wen Publishing Co.

Désiré-Marchand J. 1996. Les itineraries d'Alexandra David-Néel. Paris: Arthaud.

Diels L. 1912. Plantae Chinenses Forrestianae. Numerical catalogue of all the plants collected by George Forrest during his first exploration of Yunnan and Eastern Tibet in the years 1904, 1905, 1906. Notes from the Royal Botanic Garden, Edinburgh 31–34: 1–298.

Diels L. 1924. Plantae Chinenses Forrestianae; Catalogue of the plants (excluding Rhododendron) collected by George Forrest during his fifth exploration of Yunnan and Eastern Tibet in the years 1921–1922. Notes from the Royal Botanic Garden, Edinburgh 14 (69–70): 75–393.

Donoghue M J, Alverson W S. 2000. A new age of discovery. Annals of the Missouri Botanical Garden 87: 110–126.

Ertter B. 2000. Our undiscovered heritage: past and future prospects for species-level botanical inventory. Madroño 47: 237–252.

Gill W. 1880. The River of Golden Sand. London: John Murray.

Gippoliti S. 2005. Historical museology meets tropical biodiversity conservation. Biodiversity and Conservation 14: 3127–3134.

Gregory J W, Gregory C J. 1923. To the Alps of Chinese Tibet. London: Seeley, Service, & Co.

Handel-Mazzetti H von. 1927. A Botanical Pioneer in South West China. English trans. Winstanley D. Essex, England: Winstanley.

Herner G. 1988. Harry Smith in China—Routes of his Botanical Travels. Taxon 37: 299–308.

Holmgren P K, Holmgren N H. 1998 onwards. Index Herbariorum. New York Botanical Garden http://sciweb.nybg.org/science2/IndexHerbariorum.asp (2 February 2006).

Huc E R, Gabet J. 1928. Travels in Tartary, Thibet and China, 1844–1846. London: Routledge.

Kircher A. 1667. China Illustrata. Trans. C. van Tuyl. Bloomington, IN: Indiana Univ. 1987.

Kozloff P K. 1902. The Russian Tibet Expedition, 1899–1901. The Geographical Journal 19: 576–598.

Kozloff P K. 1908a. Through Eastern Tibet and Kam. The Geographical Journal 31: 402–415.

Kozloff P K. 1908b. Through Eastern Tibet and Kam (Continued). The Geographical Journal 31: 522–534.

Kozloff P K. 1908c. Through Eastern Tibet and Kam (Continued). The Geographical Journal 31: 649–661.

Kreft H. 2004. Diversity and biogeography of vascular epiphytes in Western Amazonia, Yasuní, Ecuador. Journal of Biogeography 31: 1463–1476.

Krishtalka L, Humphrey P S. 2000. Can Natural History Museums Capture the Future? BioScience 50: 611–617.

Kürschner H, Jerzschuh U, Wagner D. 2005. Phytosociological studies in the northeastern Tibetan Plateau (NW China)—A first contribution to the subalpine scrub and alpine meadow vegetation. Botanische Jahrbücher für Systematik Pflanzengeschichte und Pflanzengeographie 126: 273–315.

Legendre A F. 1916. Massif Sino-Thibétain; Provinces du Setchouen, du Yunnan et Marches Thibétaines. Paris: Émile Larose.

Little A. 1910. Across Yunnan: A Journey of Surprises. London: Sampson Low, Marston & Co., Ltd.

Masson D, Glidewell S M, Möller M, Mill R R, Williamson B, Bateman R M. 2001. Non-destructive examination of herbarium material for taxonomic herbarium studies using NMR imaging. Edinburgh Journal of Botany 58: 1–14.

Meier R, Dikow T. 2004. Significance of specimen databases from taxonomic revisions for estimating and mapping the global species diversity of invertebrates and repatriating reliable specimen data. Conservation Biology 18: 478–488.

Miller L. 2000. On Top of the World: Five Women Explorers in Tibet. Seattle: The Mountaineers Books.

Mittermeier R A, Myers N, Robles Gil P, Mittermeier C G. 1999. Hotspots: Earth's biologically richest and most endangered terrestrial ecoregions. Mexico City: CEMEX & Conservation International.

Mittermeier R A, Myers N, Robles Gil P, Mittermeier C G. 2004. Hotspots Revisited: Earth's Biologically Richest and Most Endangered Terrestrial Ecoregions. Mexico City: CEMEX & Conservation International.

Myers N. 1988. Threatened biotas: "Hot spots" in tropical forests. Environmentalist 8: 187–208.

Neufeld D L, Guralnick R P, Glaubitz R, Allen J R. 2003. Museum collections data and online mapping applications. Mountain Research and Development 23: 334–337.

Petersen F T, Meier R, Larsen M N. 2003. Testing species richness estimation methods using museum label data on the Danish Asilidae. Biodiversity and Conservation 12: 687–701.

Ponder W F, Carter G A, Flemons P, Chapman R R. 2001. Evaluation of museum collection data for use in biodiversity assessment. Conservation Biology 15: 648–657.

Rock J F. 1930a. Seeking the Mountains of Mystery. National Geographic 57: 131–185.
Rock J F. 1930b. The Glories of the Minya Konka. National Geographic 58: 385–437.
Rock J F. 1931. Konka Risumgongba: Holy Mountain of the Outlaws. National Geographic 60: 1–65.
Rock J F. 1947. The Ancient Na-khi Kingdom of Southwest China. Cambridge: Harvard University Press.
Roosevelt T R, Roosevelt K. 1929. Trailing the Giant Panda. London: Scribners.
Schatz G E. 2002. Taxonomy and herbaria in service of plant conservation: lessons from Madagascar's endemic families. Annals of the Missouri Botanical Garden 89: 145–152.
Soberón J M, Llorente J B, Oñate L. 2000. The use of specimen-label databases for conservation purposes: an example using Mexican Papilionid and Pierid butterflies. Biodiversity and Conservation 9: 1441–1466.
Stevens H. 1934. Through deep defiles to Tibetan uplands. London: H. F. & G. Witherby.
Stockwell F. 2003. Westerners in China. Jefferson, North Carolina: McFarland & Co.
Teichman E. 1922. Travels of a consular officer in eastern Tibet. Cambridge: Cambridge University Press.
Wieczorek J Q, Guo H, Hijmans R J. 2004. The point-radius method for georeferencing locality descriptions and calculating associated uncertainty. International Journal of Geographical Information Science 18: 745–767.