

In search of the Yulong Pincushion and Delavay's Prongwort

**David Long,
David Bell and
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report on a recent
botanical expedition
to Yunnan and
the rediscovery of
two rare Chinese
bryophytes.

The Royal Botanic Garden Edinburgh (RBGE) has a long history of botanical exploration in western China, particularly in Yunnan Province and has developed close collaboration with the Kunming Institute of Botany (KIB), part of the Chinese Academy of Sciences. Through this partnership RBGE botanists have participated in many botanical expeditions to Yunnan since 1981 when the first British expedition since the Cultural Revolution visited the Cang Shan mountains near Dali, on

which David Chamberlain was the first to make bryophyte collections. On the next expedition, the 'Chungtien-Lijiang-Dali' (CLD) expedition of 1990 (McBeath *et al.*, 1991), DGL made 884 bryophyte collections in Dali, Yulong and Zhongdian Counties, and 3 years later 1,115 bryophytes were collected on the 1993 'Kunming-Edinburgh-Gothenburg' (KEG) expedition. More recently, DGL participated in five expeditions under the 'Biotic Survey of Gaoligong Shan' from 2003 to 2007, and along with James Shevock of the California Academy

of Sciences collected around 7,700 bryophyte specimens in the Burmese border region of Yunnan (Long, 2008).

The ancient city of Lijiang in north-west Yunnan is a World Heritage Site and major tourist destination in China, celebrated for its 'old town' traditional wooden buildings now rare in China. Though devastated by a huge earthquake in February 1996, the old town has been restored and the city expanded greatly. It sits in a dramatic setting on the Lijiang Plain below the towering Yulong Xue Shan or Jade Dragon Snow

◁ West flank of the
Yulong Shan. David
Gray

Mountain (summit 5,596 m). The colourful life in Lijiang in the last years up to the communist takeover in 1949 was evocatively described by the Russian Peter Goullart (Goullart, 1955), who was a friend of the celebrated explorer and botanist Joseph Rock whose work documented the culture and language of the local minority Naxi people of Lijiang. Other botanists who studied the region's rich flora were the Scottish plant collector George Forrest, and the Austrian Heinrich Handel-Mazzetti, the latter making extensive collections of bryophytes (Winstanley 1996).

However, Lijiang and Yulong Xue Shan have to our knowledge not been explored for bryophytes since the CLD expedition in 1990.

▽ The Jade Dragon Field Station on the Yulong Shan.
D. Long



The development of the Jade Dragon Field Station near Lijiang by KIB and RBGE between 2001 and 2011 has created an excellent base for botanical, ecological and climate change research, which is now being actively encouraged by the parent organizations. Our 'Edinburgh Kunming Lijiang Expedition' (EKLE) in May 2012 included botanists from Edinburgh and Kunming, and its primary aim was to collect specimens of bryophytes and vascular plants from the Lijiang area along with silica gel material for molecular research. DGL, DB and W-ZM were the bryologists on this expedition and we collected over 800 bryophyte specimens to be deposited in the Edinburgh and Kunming herbaria. However, conditions were not ideal for bryology due to a prolonged severe drought, though some of the spectacular flowering plants, notably the rhododendrons, were in full flower.

The Yulong Xue Shan is a huge jagged line of mountain peaks largely composed of hard limestone, and the bryophyte flora is characteristically calcicolous. On the CLD expedition in October 1990 conditions were much more favourable for bryology, and the eastern slopes of the southern part of the range were found to be very rich (for example at Ma Huang Ba and Wo Tu Di which were not visited in 2012). Species recorded in 1990 included the following characteristic taxa. On limestone outcrops and boulders: *Anacolia sinensis*, *Bartramia halleriana*, *Bryoerythrophyllum wallichii*, *Campylophyllum halleri*, *Cirriphyllum cirrosum*, *Didymodon giganteus*, *D. rivicola*, *Gymnostomum calcareum*, *Hymenostylium recurvirostrum*, *Leiocolea morrisoncola*, *Metzgeria pubescens*, *Molendoa hornsuschiana* and *M. warburgii* (the last new to China), *Platydictya jungermannioides*, *Reimersia inconspicua*, *Scapania cuspiduligera*, *Schistidium trichodon* and *Tritomaria quinqueidentata*. On acidic outcrops and boulders: *Apomarsupella revoluta*, *Grimmia handelii*, *G. longipes*, *G. mammosa*, *Racomitrium albipiliferum* and *R. subsecundum*. On disturbed soil banks: *Asterella leptophylla*, *A. mussuriensis*, *A. wallichiana*, *Bryoerythrophyllum inaequalifolium* and *Solenostoma truncatum*. On animal dung on open slopes: *Tetraplodon angustatus* was abundant. On streamsides and in flushes: *Calliergonella cuspidata*, *Cratoneuron filicinum*, *Drepanocladus aduncus*, *Dumortiera hirsuta*, *Fissidens grandifrons* and *Jungermannia exsertifolia*.

On the lower slopes considerable though rather fragmented areas of forest have survived past logging operations; these are of dry *Pinus yunnanensis* and evergreen *Quercus* lower down giving way to mossy *Abies*/*Rhododendron* forests higher up. These are rich both in ground bryophytes such as *Actinotuidium hookeri*,

Plagiochila semidecurrans, *Rhytidiadelphus triquetrus* and *Rhodobryum laxelimbatum*, and with numerous epiphytes such as *Bryowijkia ambigua*, *Meteoriopsis reclinata*, *Neckera crenulata*, *N. pennata*, *Plicanthus hirtellus*, *Porella macroloba*, *P. oblongifolia*, *Sphaerothereciella sphaerocarpa*, *Struckia argentata* and *Tetralophozia filiformis*. On *Berberis* shrubs *Orthotrichum hookeri* is frequent.

The most interesting assemblage seen in 1990 was in the rocky *Rhododendron* shrubberies at 3,900–4,030 m where some of the Scottish liverwort heath species were found: *Anastrophyllum alpinum*, *Anastrepta orcadensis* and *Plagiochila carringtonii*, along with some non-British associates: *Herbertus delavayi*, *Miebea indica*, *Paraleucobryum enerve*, *Scapania ferruginea* and *S. sinikkae*.

On the 2012 expedition we planned to explore the other (western) side of the southern part of the range and to make general collections of all the bryophytes we encountered. In addition, two species discovered in 1990 we were especially keen to re-find and collect: *Ptychomitrium yulongshanum* and *Herbertus delavayi*. In the event, the western slopes proved to be less rich than the eastern, and the very dry conditions made field bryology more difficult.

Ptychomitrium yulongshanum – 'Yulong Pincushion'

The Jade Dragon Field Station sits on the southern ridge of the Yulong Xue Shan range in a picturesque setting by the Haligu Lake at 3,200 m. On the CLD expedition in 1990, Ron McBeath and DGL climbed up through the pine forest to the lake from the Camellia Temple but missed our target somewhat and ended up on a rocky ridge overlooking the lake. This detour was fortuitous as on that ridge we collected cushions of a *Ptychomitrium* which turned out



△ Left. *Ptychomitrium yulongshanum*. D. Long

△ Right. *Rhododendron decorum* on Yulong Shan. D. Long

▷ Opposite page. *Abies* / *Rhododendron* forest on the Yulong Shan. D. Long

to be new to science and 11 years later was described as *Ptychomitrium yulongshanum* (Cao & Guo, 2001), here given the common name ‘Yulong Pincushion’.

P. yulongshanum normally bears abundant sporophytes and can be easily recognized as a *Ptychomitrium* by its mitrate calyptra. It is easily distinguished from all other Asiatic species of the genus by its broadly ovate, obtuse leaves, whereas other species have narrow, lanceolate leaves with a narrowly acute or acuminate apex. Cao & Guo (2001) considered it to be most similar to the South African *P. cucullatifolium*.

On 18 May 2012, at the first attempt, we succeeded in re-finding it in three locations over

a 1 km length of the ‘Haligu Ridge’. In one of these sites it was in considerable abundance. Five days later we found a further two small colonies 1.5 km to the north on another ridge. These sites were at elevations between 3,290 and 3,456 m, where the moss grew on friable black volcanic rock which outcropped sporadically along the two ridges. The moss did not grow on the much more extensive hard volcanic rocks nearby. The general vegetation on the ridges was open *Pinus yunnanensis* woodland with an understorey of shrubs including evergreen oak *Quercus pannosa*, the juniper *Juniperus squamata* and several *Rhododendron* species, notably *R. decorum*, *R. rubiginosum* and *R. yunnanense*. Other bryophytes associated with the *Ptychomitrium* included *Frullania ericoides*, *Grimmia* sp., *Racomitrium subsecundum* and *Hedwigia stellata*.

The two perceived threats to these populations are quarrying of rock (one quarry already exists

close to these colonies) and fire which is not infrequent in the pine forests around Lijiang. In view of the highly localized occurrence of this species and the relatively small populations we suggest that this species should be added to the world ‘Red List’ of bryophytes, as a vulnerable species.

Herbertus delavayi Steph. ‘Delavay’s Prongwort’

Though described from Yunnan, the name *Herbertus delavayi* is familiar to British bryologists, as it has been suggested that it is an earlier name for the Scottish *Herbertus borealis* Crundw. based on morphological and molecular evidence (Feldberg & Heinrichs, 2005). However, the material of *H. delavayi* used in that study came from Bhutan and not from China, leaving some doubt as to its true identity. Furthermore, other workers have treated *H. delavayi* as a synonym of *H. sendtneri*

(Hattori, 1966; Juslén, 2006), while Hodgetts (2003) treated *H. borealis* as conspecific with *H. dicranus* (Taylor ex Gottsche et al.) Trevis. In a recent study of European *Herbertus* using DNA barcoding, Bell *et al.* (2012) and Bell & Long (2012) maintained *H. borealis* as a distinct taxon. In order to test these conflicting opinions, we considered it desirable to collect *H. delavayi* from as close to its *locus classicus* as possible.

The name *H. delavayi* commemorates Jean Marie Delavay (1834–1895), a French missionary and botanist (Lancaster, 1989) who travelled to China in 1867, first to Guangdong Province, and later to Yunnan. He was a prolific collector of plants, including bryophytes, and is also commemorated by the liverwort genus *Delavayella*. The type material of *H. delavayi* is labelled ‘Bois de Ma Eul Chan, 2,800 m, 9 July 1889, Delavay’ and types exist in Geneva (G), Paris (PC) and the Natural History Museum (BM) herbaria. A second collection is present in



△ Top left. *Meconopsis integrifolia* – ‘Farrer’s Lampshade Poppy’. David Gray

△ Top right. David Bell collecting *Herbertus*. D. Long

◁ Left. David Bell & Wen-zhang Ma in Kunming bryophyte herbarium. D. Long

and *Rhododendron* forest. *Herbertus dicranus* was frequent in these forests, usually growing on living trees, and in three places *H. delavayi* was also found, growing on rocks and soil, and once epiphytically on *Rhododendron*. *H. dicranus* could easily be recognized by its diffuse habit, with strongly hooked shoot tips, and leaves with long, narrow, rather flexuose lobes; *H. delavayi* grew in rigid, erect tufts with shoots tips only weakly curved, and its leaves with short lobes regularly pointing to one side.

On 26 to 29 May we visited the Ma’er Shan, ascending the mountain ridge from both the east side (from Shui He village near Songgui) and west side (from Da Songping village near Niuji Xiang), reaching 3,640 and 3,563 m respectively. However, the dominant vegetation encountered on both flanks of the range was dry *Quercus*-dominated forest, rather than humid *Abies* forest where *H. delavayi* was expected to occur. *H. dicranus* was frequent as an epiphyte but no *H. delavayi* was found. The Ma’er Shan does not enjoy any environmental protection, and logging and grazing may have changed the habitat considerably since 1889. Other parts of the Ma’er Shan could not be visited so further field work is desirable.



△ Top row. *Herbertus dicranus* (left) and *H. delavayi* (right). D. Long

△ Middle row left. Trees festooned with *H. dicranus* on the Ma’er Shan. D. Bell

△ Middle row right. Wen-zhang Ma collecting at Shuinchingo Rock. D. Long

◁ Bottom row left. Our camp below South Peak, Yulong Shan. D. Bell

◁ Bottom row right. Naxhi women in Lijiang. D. Long

Paris, from ‘*Tsang Yang Tchang, 24 May 1889, Delavay*’. The type locality corresponds to what is now known as the Ma’er Shan, between Lijiang and Dali, and the second specimen is from the Cang Shan range near Dali. Additional specimens of *H. delavayi* collected more recently exist in several herbaria from the Cang Shan and from the Yulong Xue Shan, but none has been seen from the Ma’er Shan. As all of these are too old for DNA extraction, a priority on the 2012 expedition was to visit both the Ma’er Shan and Yulong Xue Shan to search for *H. delavayi*.

On 20 and 21 May 2012, we camped at 3,900 m on the west flank of the southernmost ‘South Peak’ of the Yulong Xue Shan which gave us access to the uppermost stands of *Abies*



Bryophytes abroad – Yulong Pincushion and Delavay's Prongwort

- ◁ Top left. *Actinothuidium hookeri*. D. Long
- ◁ Top right. *Apomarsupella revoluta*. D. Long
- ◁ Bottom left. *Rhytidium rugosum*. D. Long
- ◁ Bottom right. *Paraleucobryum enerve*. D. Long
- ▽ Botanists at Jade Dragon Field Station: left to right David Bell, Gao Lian-ming, Richard Brown, David Gray and Steve Blackmore. D. Long



Preliminary study of the *H. delavayi* specimens collected on this expedition in the Yulong Xue Shan suggest they share the morphological and genetic variation contained in the '*H. cf. delavayi*' clade discussed in Bell *et al.* (2012). It is hoped further study will provide a better understanding of the diversity exhibited by this species and greater resolution of this group, which includes the rare Scottish endemic *H. borealis*.

Following the expedition, our collections of bryophytes will be curated and a labelled set returned to Kunming. Many collections of *Herbertus* were dried in silica gel, and as a priority those of *H. delavayi* and *H. dicranus* will be sequenced for comparison with samples of European and North American *Herbertus*, as the next stage in our on-going project using

DNA barcoding to shed light on the complex taxonomy of the 'Prongworts'.

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References

Bell, D., Long, D.G., Forrest, A.D., Hollingsworth, M.L., Blom, H.H. & Hollingsworth, P.M. (2012). DNA barcoding of European *Herbertus* (Marchantiopsida, Herbertaceae) and the discovery and description of a new species. *Molecular Ecology Resources* 12, 36–47.

Bell, D. & Long, D.G. (2012). European *Herbertus* and the 'Viking prongwort'. *Field Bryology* 106, 3–14.

Cao T. & Guo S. (2001). *Ptychomitrium yulongshanum*, n.sp. from China. *Bryologist* 104, 303–305.

Feldberg, K. & Heinrichs, J. (2005). On the identity of *Herbertus borealis* (Jungermanniopsida: Herbertaceae), with notes on the possible origin of *H. sendtneri*. *Journal of Bryology* 27, 343–350.

Goullart, P. (1955). *Forgotten Kingdom*. London: John Murray.

Hattori, S. (1966). Bryophyta: Hepaticae and Anthocerotae. In *The Flora of Eastern Himalaya*, pp. 501–536. Edited by H. Hara. Tokyo: Tokyo University Press.

Hodgetts, N.G. (2003). Some synonyms of *Herbertus dicranus* (Taylor ex Gottsche et al.) Trevis. *Journal of Bryology* 25, 138–140.

Juslén, A. (2006). Revision of Asian *Herbertus* (Herbertaceae, Marchantiophyta). *Annales Botanici Fennici* 43, 409–436.

Lancaster, R. (1989). *Travels in China*. Woodbridge: Antique Collectors' Club.

Long, D.G. (2008). Bryophytes abroad: the Gaoligong Shan mountains of the Sino-Burmese Border. *Field Bryology* 96, 28–38.

McBeath, R.J.D., Long, D.G. & Paterson, D. (1991). *Report of the 1990 Chungtien–Lijiang–Dali Expedition*. Unpublished report. Edinburgh: Royal Botanic Garden.

Winstanley, D. (1996). *A Botanical Pioneer in South West China*. Brentwood: privately published. [Translation of Handel-Mazzetti, H. (1927). *Naturbilder aus Südwest China*. Vienna: Österreichischer Bundesverlag.]