

FIRST RECORD OF *ISOPACHES DECOLORANS* (MARCHANTIOPHYTA, LOPHOZIACEAE) FROM XIZANG, CHINA

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Abstract. *Isopaches decolorans* (Limpr.) H. Buch, a rare, arctic and alpine species with remarkably disjunct distribution of the northern hemisphere, is found for the first time in Xizang (Tibet), China. In China it is a poorly known liverwort previously reported only from Sichuan and Yunnan. The colorful illustrations and detailed description of *I. decolorans* are provided, and SEM observation of elaters and spores is presented for the first time.

Key words: Anastrophyllaceae, *Isopaches*, Lophoziaceae, Scapaniaceae, spore, Tibet

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INTRODUCTION

Isopaches H. Buch, an oligotypic genus, was established by Buch (1933). Schuster (1951) treated *Isopaches* as a subgenus of *Lophozia* (Dumort.) Dumort., but molecular evidences in recent years revealed that *Isopaches* should be recognized at generic level (De Roo *et al.* 2007; Crandall-Stotler *et al.* 2009; Vilnet *et al.* 2010). *Isopaches* contains four species. One species, *I. bicrenatus* (Schmid. *ex* Hoffm.) H. Buch, is very widespread in the boreal and temperate regions of the northern hemisphere. Two other species, *I. pumicicola* (Berggr.) Bakalin is known from New Zealand (Bakalin 2008) and *I. alboviridis* (R. M. Schust.) Schljakov mainly in West Greenland, Alaska and Siberia (Schuster 1969; Potemkin 1990, 1993). The fourth, *I. decolorans* (Limpr.) H. Buch, is reported as a rare and highly disjunct species which is known from Central Europe, Scandinavia, west and east Siberia, Bhutan, Nepal, tropical Africa and British Columbia (e.g., Müller 1951–1958; Potemkin 1990, 1993; Schuster 1995; Váňa 2004; Long 2005). In China *I. decolorans* is still poorly known. The first report for this species in China

was made by Long (2005 as *Lophozia decolorans*) who found it in Deqin Co., North-west Yunnan. During recent expedition to China, Long (2011 as *L. decolorans*) reported its occurrence in the alpine area in south-west Sichuan. In July 2012 the senior author of this paper found fertile populations in east Xizang. Although *I. decolorans* spreads in some regions of Asia, no full illustrations and detailed description based on Asian samples are available except the only description based on specimens from Yamal Peninsula (Potemkin 1990). This paper aims to report the new locality, provide a colorful illustration and detailed description, present SEM observation for the first time, and discuss the morphological variations.

MATERIAL AND METHODS

The samples were collected in Linzhi Co., Xizang, China on 28 July 2012. Materials for SEM studies were without chemical treatment, mounted on mental stubs, and then coated with gold. SEM micrographs were made with a Hitachi S4800 scanning electron microscope. The

cross sections of the stem and capsule were carried out by cryostat microtome (Leica CM1900). The samples were embedded in compound OCT (Tissue-Tek OCT compound 4583), frozen at minus 20 degrees Celsius and cryo-sectioned. The stems were stained by neutral red before embedded in OCT. Samples for LM studies were examined under a light microscope (Zeiss Imager A1 or Olympus BX 43). The photos were taken with Spot Flex digital camera and Olympus DP 71 digital camera. The field pictures were photographed with a digital camera (Canon G11).

DESCRIPTION

Isopaches decolorans (Limpr.) H. Buch

Figs 1 & 2

Mem. Soc. F. Fl. Fenn. **8**: 288. 1932. = *Jungermannia decolorans* Limpr., Jahrb. Schles. Gesell. Vaterl. Kult. **57**: 116. 1880. = *Lophozia decolorans* (Limpr.) Steph., Sp. Hepat. **2**: 147. 1902.

Plants yellowish green, more or less reddish when old, creeping, closely attached or semi-immersed to substrate. Shoots very compact, silkworm-shaped, julaceous, 0.8–3.0 mm long, 0.60–0.75 mm wide. Stem simple to scarcely branched, 8–10(–11) cells high, cross-section subelliptical, 263–366 × 171–283 μm; medulla homogeneous with large, somewhat thick-walled, nearly round cells; dorsal cortical cells similar to medullary, while ventral cortical cells slightly to scarcely smaller, and walls of ventral cortical somewhat thicker than the medullary and dorsal layer. Leaves erect, sub-transversely inserted, laterally oppressed to the stem, densely imbricate, more or less decolorate at distal part, broadly orbicular to reniform, 0.55–0.67 mm long, 0.58–0.85 mm wide, subsymmetrically bilobed to 0.1–0.2 their length, occasionally very shallowly 3-lobed, lobes broadly triangular, sinus widely V-shaped to crescentic, margin entire. Leaf cells subquadrate to rectangular, thick-walled, trigones indistinct, cuticle smooth, marginal cells 17–30 × 12–23 μm, median cells 20–38 × 15–25 μm, basal cells 25–45 × 15–33 μm; oil bodies grayish, spherical to ovoid, granular, 3–9 per cell, 5.6–8.2 × 1.8–5.6 μm, often absent in discoloured portion. Underleaves absent. Rhizoids numerous, long,

colorless to light brown, densely spreading along ventral surface of stem.

Dioicous (male plants not found). Gynoecea terminal from short, unbranched shoots. Bracts in 3 pairs, closely compact together, strongly concave or cupped, usually decolorate toward apex, broadly ovoid-subrotund to slightly reniform, larger than leaves, 0.54–1.29 mm long, 0.67–1.77 mm wide; irregularly 2–3-lobed, lateral margins usually entire, rarely weakly dentate, apical margin irregularly toothed often ending in 1–2(–3)-celled apiculus apically. Perianth half-exserted, shortly cylindrical, usually decolorate especially in the upper portion, 1.6–1.8 mm long, 0.7–0.8 mm wide at middle, bearing 5 smooth keels variable in both shape and size, mouth apex nearly truncate, margin usually scattered crenulate to 1(–2)-celled toothed. Seta 2.5–5.5 mm long, 5–7 cells (247–302 μm) in diameter, in transverse section with 16 external cells and ca. 10 inner cells. Capsule ovoid, brownish black, 735–848 × 604–673 μm, dehiscent into 4 equal, symmetrical, nearly oblong-lanceolate valves separated from apex down to base, capsule wall 2-stratose, cells of outer layer larger than those of inner layer, outer and inner layer both with incomplete semi-annular bands and vestigial nodular thickenings; elaters bispiral, brown, filiform, rarely branched, attenuate to both ends, 107–314 μm long, 7.7–10.8 μm wide, spiral band of thickenings 2.7–3.1 μm wide. Spores red-brown, spherical, 13–23 μm in diameter, surface densely corrugate with irregular, often short to long and branching ridges, ridges nearly smooth, raised at nodes to truncate processes on top, spaces somewhat deep, little wider than ridges. Asexual reproductive organs not seen.

SPECIMEN EXAMINED: CHINA. XIZANG, Linzhi Co., Sejilashan, mountain pass, 29°36'38.77"N, 94°39'06.92"E, on soil, 4720 m, 28 July 2012, *Rui-Liang Zhu 20120728-9* (HSNU).

DISCUSSION

MORPHOLOGY

Most authors (e.g., Schuster 1995; Boudier & Skrzypczak 2002; Vána 2004; Oyesiku 2008)



Fig. 1. *Isopaches decolorans* (Limpr.) H. Buch. A – Field plants on soil in Linzhi Co., Xizang; B – capsule with part of seta; C – transverse section of seta, D – female shoot bearing mature sporophyte with dehiscent capsule, releasing spores and elaters, E – capsule dehiscent into four valves, F – transverse section of perianth, showing five keels, G – elater and spores, H – branched elater and spores, I – female bract, J & K – leaves, L – transverse section of stem and leaf-base, M – sector of transverse section of capsule wall, N – cells of inner layer of capsule, O – cells of epidermal layer of capsule, P – median cells of leaf showing oil bodies, Q & R – part of perianth mouth, S – sterile shoot, lateral aspect. All from R.-L. Zhu 20120728-9 (HSNU).

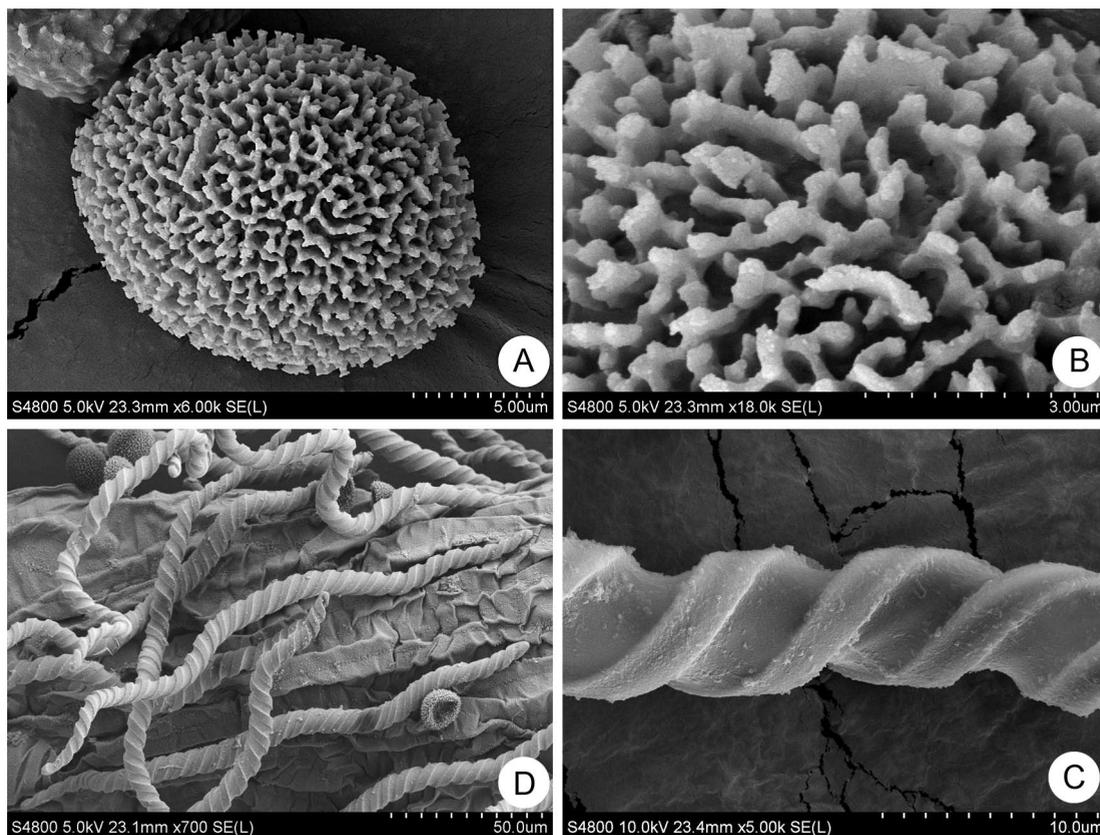


Fig. 2. SEM micrographs of *Isopaches decolorans* (Limpr.) H. Buch. A & B – spore morphology and ornamentation, C & D – elater morphology and spiral band of thickenings. All from *R.-L. Zhu 20120728-9* (HSNU).

reported that *Isopaches decolorans* was dioecious, while Potemkin (1993) noted that ‘sex distribution is not constant in arctic populations of *Isopaches* species’, *I. decolorans* in Yamal Peninsula, west Siberian arctic, is paroecious. In Xizang samples, we have neither found antheridia below the perianth, even nor found androecia (Fig. 1A & D). The local *I. decolorans* seems to be dioicous.

The leaves of *I. decolorans* are usually bilobed, but the sinus was reported to be different in width or depth. In the American plant the leaf sinus is 0.10–0.15 leaf length, 0.20–0.45 leaf width (Schuster 1995). In the plant from Mt. Kenya, Africa (Chuah-Petiot 1995), it is bilobed to ca 1/3 its length, or shallow lobes ‘not widely separate’ from Uganda (Váňa 2004). In the Chinese samples of the present collection leaves are occasionally

3-lobed, and have widely V-shaped to widely crescentic sinus, 0.30–0.47 leaf width and 0.09–0.17 leaf length (Fig. 1J & K).

The female bracts in the Xizang collection are broadly ovoid-subrotund to slightly reniform in shape, the widest nearly in the middle, and apex slightly contracted, irregularly 2–3-lobed, apical margin irregularly toothed (Fig. 1I). It differs from American plant in which the widest part is in basal third, distal part strongly contracted into two, almost juxtaposed lobes and the margin appears entire (Schuster 1995).

The perianth is somewhat different from the former reports. Müller (1905–1916) recorded that the perianth was entire and crenulate, Schuster (1995) stated the perianth mouth was variable in the degree of dentition, Potemkin (1993) noted

that the perianth mouth was ‘shortly ciliate, cilia 1–2(3)-celled’, and ‘crénelée-dentée’ in French specimens (Boudier & Skrzypczak 2002). Our observation shows that mouth apices are nearly truncate with 1-celled crenulate to 1(–2)-celled toothed margin (Fig. 1Q & R), which are very closely to the description of African plant (Váňa 2004).

The SEM morphology of elaters and spores of *I. decolorans* is reported for the first time in this paper (Fig. 2). The elater is bispiral (Fig. 1G, 2C & D), and sometimes bifurcate (Fig. 1H). Spore sexine surface has corrugate and branching ridges with processes on top (Fig. 2A & B), the ridges and processes are thinner than the processes of *I. bicrenatus* spores. In *I. bicrenatus* surface processes of the spores are ‘irregular pilum- or barculus-like’ (Boros *et al.* 1993).

The gemmae of *I. decolorans* are intense to yellow reddish colored, usually 1–2-celled and 4–5 angled, shape variable from stellate (Arnell 1956) in European plants, quadrate or subquadrate from America and Africa (Schuster 1995; Váňa 2004), to irregularly polygonal, rectangular and triangular from Russia (Potemkin 1990, 1993), but in the Xizang population no gemmae are found.

DISTRIBUTION

Isopaches decolorans was known as a rare and local European alpine species previously in France, Switzerland, Austria, Norway (Müller 1905–1916, 1951–1958; and others), Italy (Aleffi *et al.* 2008), etc. Schuster (1995) reported it for western north America. *I. decolorans* has also been found from Asia and Africa continually in recent years. In Asia the first record of this species was made by Ladyzhenskaya and Zhukova (1971) who reported its occurrence in Tomponskii Region of Yakutia, then Schljakov (1974), Potemkin (1990, 1993), Schuster and Konstantinova (1996), Bakalin (2005), Oyesiku (2008), and Potemkin and Sofronova (2009) recorded it for Russia mainly covering Siberia and Caucasus. In addition to the above distributions in Asia it is mainly reported for Himalayan region including Bhutan (Long 1979), Nepal, India (Sikkim), China (Sichuan, Yunnan) (Long 2005, 2011). In Africa, *I. decolorans* is lo-

cated in Cameroon, Tanzania (Váňa 1982; Bizot *et al.* 1985), D.R. Congo (Nyiragongo) (Müller 1995), Uganda (Mbale) (O’Shea *et al.* 2003) and Equatorial Guinea (Bioko) (Müller 2006). The species spreads over equatorial Africa and deeply into the tropics, which indicated the distribution of *I. decolorans* is not confined in Europe alpine or arctic region, and maybe in more temperate and tropical alpine areas. It is inclined to be overlooked with small size, and this might result in rare reports in these areas previously.

So far *Isopaches decolorans* is the unique species of *Isopaches* found in China. Long (2005) first reported *I. decolorans* from Yunnan Province as a new hepatic record to China, and suggested that ‘*I. decolorans* (= *I. decolorans*) may be a more widespread and locally abundant species in the East Himalaya and possibly also in Western China, than in other parts of range’. Six years later he reported *I. decolorans* for south-west Sichuan (Long 2011). The present record in Linzhi, Xizang is the third locality of this species in China and it is the first report for this region.

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