New Zealand's rarest liverwort found and lost again in Hornby

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Introduction

Campbell (1987) described a new liverwort *Steereomitrium minutum* E.A.Campb. [= *Haplomitrium minutum* (E.A.Campb.) J.J.Engel & R.M.Schust.] from plants found in turf trial plots at the Turf Research Institute near Palmerston North, New Zealand. It was growing among *Leptinella maniototo*. Campbell (1987) commented that it occurred as a weed in a *Leptinella maniototo* turf at the bowling green of Cashmere Bowling Club in Christchurch although she had not been to the bowling green herself. The Cashmere Bowling Club green has not been searched for the plants. She believed that the *Leptinella maniototo* plants originated from Dunback, Otago. David Havell, who was involved in the turf trials, thought that the turf came from coastal Southland where it grew with *Leptinella dioica* (David Havell, pers. comm., 2006). No further plants of *Haplomitrium minutum* were found in New Zealand but Masuzaki et al. (2010) believed they had found the species in Japan. Sato and Katagiri (2016) assigned the Japanese plants to *Haplomitrium hookeri*, which is widespread but very sparse in the Northern Hemisphere temperate zone.

It needs to be mentioned that *Haplomitrium* is special in the liverworts as being sister to the rest of the liverworts and has the simple morphology of the first land plants that evolved from green algae, with an erect stem and three ranks of undifferentiated leaves. *Haplomitrium* receives far more attention from bryologists than other liverworts. For instance, Bartholomew-Began's (1991) 300-page monograph of the genus is a study that focuses on establishing the primitive features of the first land plants.

In 2017 I found a wild population of *Haplomitrium minutum* in Hornby at a site where Bryony Macmillan had collected *Fossombronia wondraczeckii*. It was growing on the vertical side of a drainage ditch in the road-verge lawn of a house whose owners kept the lawn very short. The location was on the north-west corner of Marshes Road and Shands Road. The ditch ran parallel to and 2 m from Marshes Road (Fig. 1).

Figure 1. The drain at the corner of Marshes and Springs roads in October 2019, including spray-painted posts that warned that the site was soon to go. The occupiers of the house had attempted to mow the lawn soon after the posts were driven in.

The ditch was not a natural streamway since it was parallel to the road. The accompanying bryophytes included eight native bryophyte species and one adventive bryophyte, *Lunularia cruciata* (Fig. 2). The plants were mostly solitary, growing mostly among *Anthoceros laminiferus* and *Fossombronia wondraczeckii*, but sometimes there were clusters of several male plants. In total the 50 metre-long bank had about 100–200 plants.

Figure 2. The rich mixture of mostly native hornwort, liverwort, and moss species that the *Haplomitrium* was growing in.

The plants fit *Haplomitrium minutum* as described by Campbell (1987) and Engel and Schuster (1994). Male and female plants were both present and female plants produced capsules in mid-October. Male plants were ca. 7 mm tall, female plants ca. 4 mm tall to the base of the calyptra [plants 3–20 mm tall in Campbell (1987)]. The capsule was 2 mm long (Figs. 3–5, below and p. 36). The plants are much too small to be either *Haplomitrium gibbsiae* or *H. ovalifolium*, the other two species present in New Zealand.

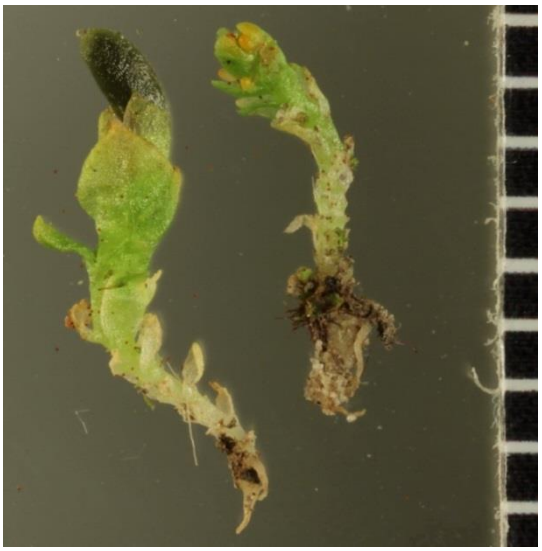

Figure 3. Male and female plants of *Haplomitrium hookeri* (CHR 639876) with an immature capsule protected by a calyptra and a millimetre scale.

Figure 4. Male and female plants of *Haplomitrium hookeri* (CHR 639876) with a mature capsule on an elongated seta.

They are similar in size to *H. hookeri* in alpine Japan, which were 3–6 mm tall (Sato and Katagiri 2016). Spores are similar to those of the type of *Steereomitrium minutum* in Campbell (1987) and Sato and Katagiri (2016) who re-examined the type, and to spores of *Haplomitrium hookeri* illustrated by Brown et al. (2015), although the ornamentation is not identical to that of spores illustrated in those three publications (Fig. 6). The plants did not have gemmae as reported for Japanese plants by Furuki (1986).

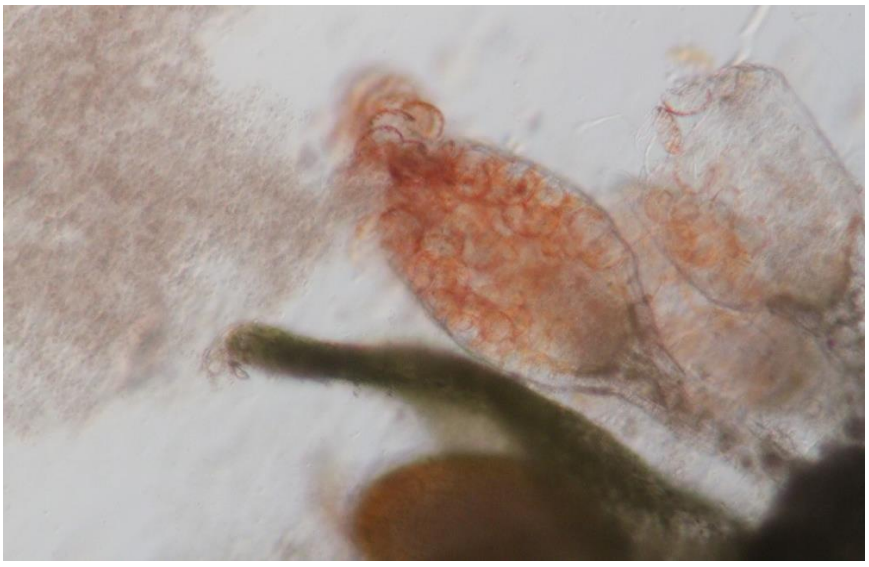

Figure 5. An antheridium of *Haplomitrium hookeri* (CHR 639876) releasing sperm. Sperm cells of *Haplomitrium* have an unusual form and have been studied to test the hypothesis that the liverworts were the first land plants to evolve from algae.

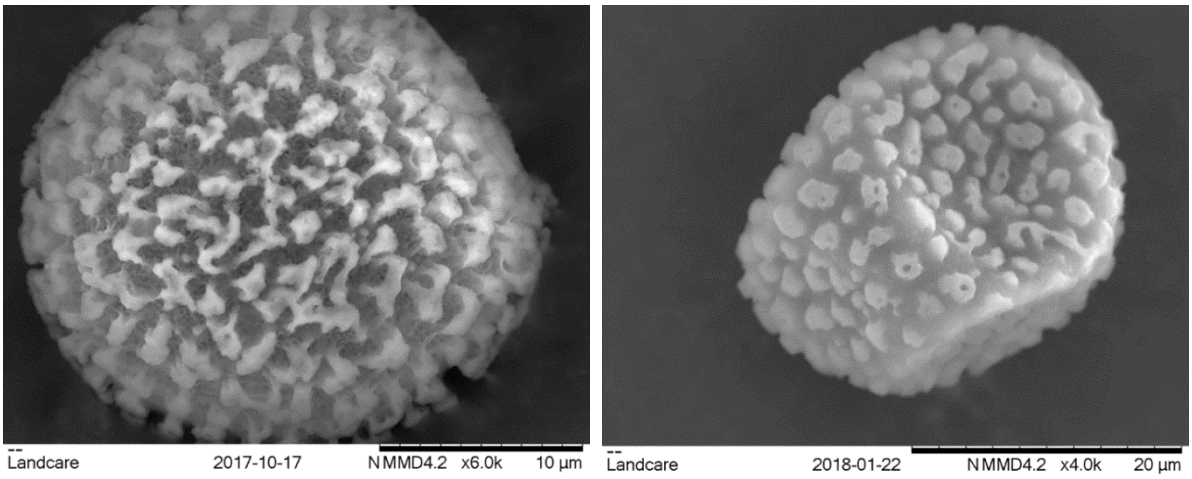

Figure 6. Spores of *Haplomitrium hookeri* from Marshes Road (on left), and from Canada (W. Schofield 40022, Field Museum) (on right).

Fresh plants from Hornby were sequenced by Rob Smissen at Manaaki Whenua for rbcL and the trnL intron. The new sequence was nested within those of *Haplomitrium hookeri*. The rbcL sequence placed it closest to a sequence derived from plants collected on a stream bank in *Tsuga – Rhododendron* forest in the upper Salween River in Yunnan Province, China (published in Chang and Graham 2011). Bartholomew-Began (1991, p. 235) believed that *Haplomitrium minutum* was a synonym of *H. hookeri* and this is consistent with the rbcL DNA sequence. However, Rob Smissen found considerable genetic variation among species of *Haplomitrium* in the trnL intron. Because the sample used by Chang and Graham was only sequenced for rbcL, the less variable gene region, the near-relationship of the Hornby plants to the Yunnan plants can't be confirmed.

The question arises whether *Haplomitrium hookeri* is native or adventive to New Zealand. Campbell (1987) described her plants as a weed in a turf trial, and the immediate source of the plants she believed to be an urban bowling green. The habitat at Hornby was the bank of a drain rather than a natural stream, although most of the bryophytes with which it was found were native.

Very few New Zealand liverwort species are regarded as adventive. Evidence of a species being adventive is from five avenues: date of first collection, evidence of an expansion of range within New Zealand, links to a country of origin, whether the habitat is disturbed, and whether one or both sexes are present for dioecious plants.

Lunularia cruciata is the best documented example of a New Zealand adventive liverwort species: first collected in the Manawatu Gorge by Victor Zotov in 1929, and in Hawkes Bay by Amy Hodgson in 1930. First collections on Stewart Island and in Westland were made as recently as 2012 and 2016 and it is still absent from roadside habitats in North Taranaki, suggesting that it is still expanding its range.

Haplomitrium hookeri is a tiny plant. I didn't notice the plants at the collecting site on my first visit and only saw them under the microscope while examining the *Fossombronia* they grew with. For this reason, evidence from date of first collection and expansion of range cannot be used for this species. However, the DNA evidence that the plants are genetically closest to Chinese plants is strong evidence for its being native, since an accidental introduction on soil from China is far less likely than from Europe. The degree of genetic difference between the New Zealand and Chinese plants is also evidence of its being native. So is the presence of both male and female plants at the site.

The fate of plants at the Hornby site

While visiting the site in October 2017 I noticed survey stakes around the drain and was aware that the area would be disturbed by roadworks associated with the southern motorway. Indeed, while I was away biking from Cape Reinga to Bluff in March 2018 the drain was dug up and a concrete underground pipe put in its place; needlessly, in my opinion, as Marshes Road west of Shands Road carries hardly any traffic and the road itself remains unchanged. I regret that I didn't attempt to translocate the plants to another drain nearby. During Covid lockdown in April 2020 I searched several kilometres of roadside drains in the Hornby–Prebbleton area for *Haplomitrium hookeri* without success. What was unusual about the now-lost site was that the occupiers of the property (the property was compulsorily acquired under the Public Works Act in 2000) were assiduous in mowing their road-verge lawn and trimming grasses on the vertical sides of the bank. As a result the tiny plants were never smothered by tall grasses. Most roadside drains are not manicured to this degree and so are unsuitable habitat for the species.

If *Haplomitrium hookeri* is native to New Zealand it is likely to be widespread but very sparse. Japanese plants were alpine (Masuzaki et al. 2010). In New Zealand a natural habitat of the species may be coastal and lowland turflands. Coastal Southland and Stewart Island are likely places for it to be found.

The Canterbury Plains seems an unlikely place for such a species because of the low annual rainfall (640 mm at Lincoln). However, the Marshes Road drain had water flowing in it year-round, probably because it was spring-fed. When we think of reserves on the Canterbury Plains we think of dryland reserves (e.g. at Bankside and Eyrewell) but the importance of habitat beside spring-fed streams needs more recognition. These habitats may be tiny, as in this case where the valuable habitat was less than 100 square metres.

Specimen examined

Haplomitrium hookeri New Zealand, Canterbury, Christchurch, Hornby, Marshes Road 100 m from Shands Road junction, 172.50415° E -43.56212° S, elevation 20 m, vertical side of shallow drainage ditch 1 m wide with 10 cm of water flowing over bed of *Elodea canadensis*, surrounding area is mown lawn; growing in soil in a dense bryophyte mat of *Lunularia cruciata*, *Anthoceros laminiferus*, *Bryum billardierei*, *Chiloscyphus erosus*, *C. subporosus*, *Fossombronia wondraczeckii*, *Philonotis tenuis*, *Sagina procumbens*, *Triquetrella papillata*, and *Trichocolea rigida*; D Glenny 14122, 2 October 2017, CHR 639876, F.

Acknowledgments

I wish to thank Rob Smissen for sequencing the Hornby plants and for comparing the sequence to other published sequences, and for discussion of the significance of the level of difference between the sequences. I thank John Engel for discussion of the plants and for lending a specimen of *Haplomitrium hookeri* collected in Canada for comparison with the New Zealand plants.

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Two new aquatic moss records for Christchurch from Travis Wetland

Eleanor Bissell and Bryony Macmillan

A preliminary survey of the mosses of Christchurch City was completed in 2004 (Macmillan 2004). Although the sanctuaries Otukaikino and Travis Wetlands were visited, there remained much to be learnt in these aquatic habitats.

Mosses were collected by the first author in 16 numbered plots, which are related to soil type (Orwin 2005), from June 2014 to September 2015.

Aulacomnion palustre (Plot 3). This is the first collection of wild origin from a lowland site.

Distichophyllum pulchellum (Plot 1). Rare on the Plains and Banks Peninsula

Acknowledgements

We thank Allan Fife for examination of *Aulacomnion* and Sue Gibb for accessioning specimens to the Allan Herbarium, Manaaki Whenua – Landcare Research, Lincoln.

References

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