

The elusive green alga *Catena viridis* Chodat: a possible second record for the British Isles from Scotland

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This note concerns an unusual algal specimen that was recorded in a sample collected from Loch Ore, Fife, Scotland on 14th August 2024, during a routine phytoplankton analysis carried out as part of the Scottish Environment Protection Agency's (SEPA) monitoring of the ecological status of freshwater lochs using phytoplankton. The open-water sample had been collected using a throw sampler from the shore at the north-eastern edge of the loch at the yacht jetty near the outlet, and immediately preserved with Lugol's solution. Loch Ore is a large (surface area 0.85 km², volume 4.47×10⁶ m³), shallow (mean depth 5.3 m), high alkalinity (mean alkalinity 1,788 µEq L⁻¹, mean colour 29.3 mgPt L⁻¹) freshwater loch. Its catchment area (24.32 km²) is coniferous woodland (33%), improved grassland (23%), arable horticulture (12%) and broadleaved woodland (8%). The overall ecological status of the loch is currently classified as "Moderate", while the phytoplankton has reached "High" ecological status (SEPA, 2025) and has been usually dominated by diatoms (*Cyclotella* spp. and *Acanthoceras zachariasii*), cryptophytes (*Cryptomonas* spp.) and chlorophytes (*Pediastrum* spp. and *Pandorina morum*) over 2022-2024 (data from months of July to September only).

No live sample could be taken and used for examination. Photographs taken from the sample at ×1,600 magnification (oil immersion) highlighted cells 4-5 µm long by 1.0-1.5 µm wide, bar-bell-like with thickened caps at either end (Fig. 1). Cells were relatively abundant at 4,953 cells ml⁻¹ with calculated biomass of 5,312 µm³ ml⁻¹. These cells in the preserved sample from Loch Ore show a close resemblance to *Catena viridis* (Chodat, 1900), a green alga belonging to the Chlorellales (Trebouxiophyceae) as indicated by its morphology and size and based on detailed descriptions in authoritative sources: Bourrelly (1990), Tikkanen (1986) and Hindák (1978).

Bourrelly (1990) mentions *C. viridis* as being known only from Denmark, Sweden and France, with each end of the cylindrical cells widening into projecting edges encrusted with brown ferric salts, and with four or eight



Fig. 1. Cells from Loch Ore (August 2024). Scalebar = 10 µm.

of these cells forming short, straight or tortuous filaments. Guiry & Guiry (2024) state that this plankton alga is found in various freshwater habitats in central Europe as well as in Côte d'Ivoire in West Africa. John *et al.* (2011) quoted the comments of Williams (1941) concerning his record of *C. viridis* from the River Dee (near Chester, Cheshire, England) that the ring-like thickening was sometimes broken into granules. These observations were in error, since Williams (1965) subsequently corrected his identification to "*Amphikrikos minutissima*" (*sic*) (= *A. minutissimus*, a new species and genus described by Korshikov in 1953). John *et al.* (2011) describe *C. viridis* as having cylindrical cells, 3-4 µm wide, one to two times longer than broad, with ends often encircled by unequal caps or rings.

There is only a superficial resemblance between the rare chlorococcal alga *A. minutissimus* and the specimens from Loch Ore. The most recent morphological description and taxonomic comments on *A. minutissimus* refer to samples from Slovakia (Hindák & Hindáková, 2008). These authors described *A. minutissimus* as follows: "Cells solitary or arranged in 4-8 celled autosporangia, with indistinct hyaline mucilaginous envelopes. Cells were short cylindrical to cylindrical-oval, 5-7 × 2-3.5 µm... with a ring of irregular granules at both poles". Hindák & Hindáková (2008) also discuss the placement of *A. minutissimus* in the family Oocystaceae (order Chlorellales) based on the presence of autosporangia. In contrast, *C. viridis* reproduces only by transverse cell division and is now placed in the family Chlorellaceae (order Chlorellales) based on the findings of an 18s RNA investigation (Krienitz *et al.*, 2003).

An examination of detailed illustrations of both *C. viridis* and *A. minutissimus* from the unique Fritsch Collection, a detailed herbarium of millions of algal illustrations dating from 1912, also enabled comparison of the Loch Ore sample with different authors' interpretation of these two taxa. The cells of the Loch Ore sample more closely correspond to the illustrations of *C. viridis*, although these were not observed forming short chains, which possibly reflects the treatment of the sample after collection. As it was not possible to take a live sample from Loch Ore in August 2024, other aids to identification - the original colour of the cells and the nature of the chloroplast - remain unknown. The record of *C. viridis* therefore remains inconclusive.

Allan Pentecost (pers. comm.) suggested adding dilute acid to the sample to determine if the objects remained - indicating they are algal, or if they completely dissolved - suggesting they were not algal but mineral. The addition of dilute hydrochloric acid resulted in the apical thickened caps dissolving but leaving the cells unaffected and intact (Fig. 2). All other algal cells remained unaffected and intact in the sample after the addition of acid. This further strengthens the case for these cells being attributed to the green alga *C. viridis*.

If the Loch Ore sample proved to be *C. viridis*, then it would be only the second time this species has been recorded from the British Isles, now that the original report of it from the River Dee is known to be erroneous (Williams, 1965). The only other record is the mention by Pentecost & Haworth (2021) that it was recorded by John Lund in 1996 from Priest Pot in a list of the freshwater algae of Cumbria that includes the English Lake District.

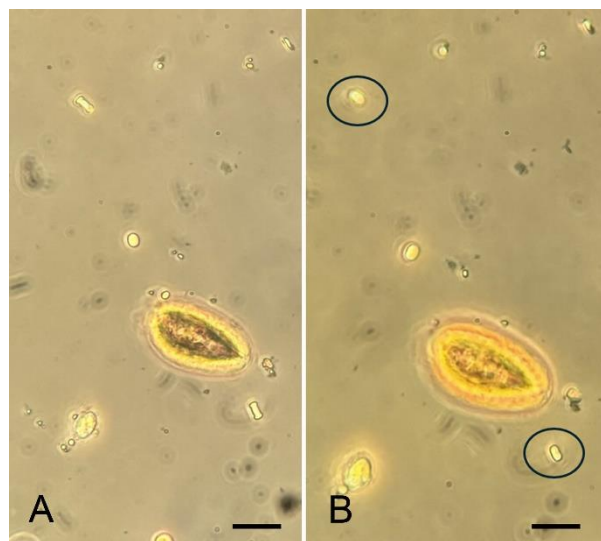


Fig. 2. Cells from Loch Ore (August 2024). (A) Prior to addition of dilute hydrochloric acid, showing thickened caps containing brown ferric salts. (B) Immediately after addition of dilute hydrochloric acid showing intact cells (encircled) and dissolved caps. Scalebars = 20 µm.

In conclusion, the cells observed in the sample collected from Loch Ore in August 2024 are very likely those of the rare green alga *C. viridis*, only the second time it has been recorded from the British Isles. Further collections of live material subsequently preserved in glutaraldehyde or formalin are needed for confirmation. The authors thank the large number of algologists in the U.K. and further afield who provided valuable comments on JK's initial query about this specimen: Bill Brierley, Laurence Carvalho, Marko Järvinen, David M. John, Martyn Kelly, Sarah Pritchard, Kristiina Vuorio, and Allan Pentecost. Special thanks go to Joanna Wilbraham and Robert Mrowicki at the Natural History Museum (London) who copied relevant sheets from the Fritsch Collection of Algal Illustrations. Thanks are also due to two anonymous reviewers who provided very helpful comments on this note.

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