Gerhardtia cf. *borealis* a species new to Britain

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The summer of 2023 proved to be a great one for the Warwickshire Fungus Group in terms of finding uncommon species. During periods when there were barely any mushrooms around, interesting fruit bodies like *Gyrodon lividus*, *Gyroporus castaneus*, *Elaphomyces granulatus*, *Leccinum crocipodium*, *Volvariella bombycina*, etc., were found. However, finding a very attractive and unusual red capped mushroom was the icing on the cake (Figs 1–3).

On 21st July 2023, members of the Warwickshire Fungus Group visited Brandon Reach Nature Reserve, one of our most frequented places for fungus surveys. It is owned and managed by the Warwickshire Wildlife Trust, has a mosaic of habitats comprising grassland, scrub, early successional woodland and ancient woodland, so a wide variety of wildlife and fungi can be found across the site.

It was here where the peculiar reddish fruiting bodies were found under a sycamore tree. Unfortunately, most of the mushrooms had been eaten by animal(s), but the remaining macroscopic features (convex, vinaceous-brown, cartilaginous cap with an inrolled margin, no veil on the stipe, pale gills and fibrillose stem), farinaceous (floury) smell and growing in dense clusters in disturbed soil (Fig. 2), combined to resemble a species in the *Lyophyllum decastes* group. A voucher (a mushroom sample) was taken for further analysis..

Under the microscope, the finely ornamented (superficially marked) cream spores Fig. 4) and the basidia lacking clamped bases did not match any *Lyophyllum* species in our literature, so this level of analysis was inconclusive.

Around that time, the possibility of getting into DNA sequencing had been raised and BMS DNA barcoding talks had been discussed among the group with growing interest. So it was decided to give DNA sequencing a try for this odd specimen. A voucher was dried and sent to Alvalab in Spain for DNA extraction and

Fig. 1. *Gerhardtia* cf. *borealis*, Brandon Reach Nature Reserve, Warwickshire, July 2023. GenBank accession number OR635660. Photograph © Francisco Verenciano.

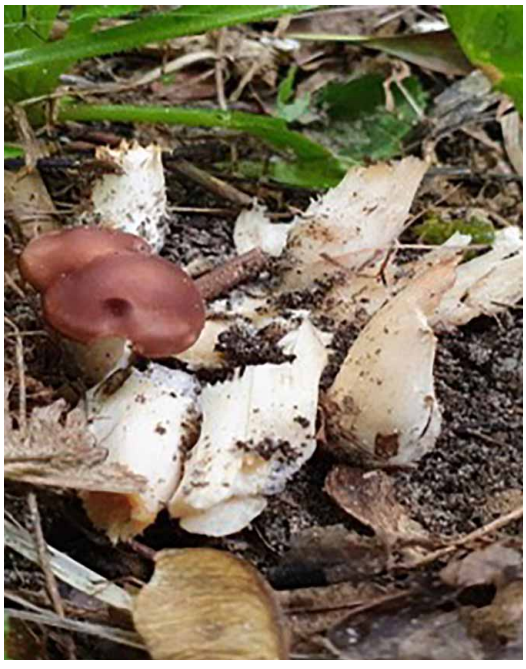

Fig. 2. *Gerhardtia* cf. *borealis* showing clustered growth. Photograph © Francisco Verenciano.

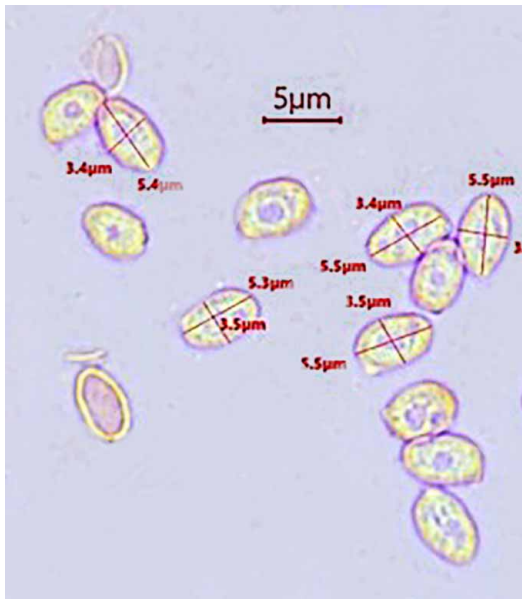

Fig. 4. *Gerhardtia* cf. *borealis*, ellipsoidal, irregular basidiospores measuring 5.3–5.5 x 3.4–3.5 µm. Photograph © Francisco Verenciano.

Fig. 3. *Gerhardtia* cf. *borealis* inrolled cap margin and pale gills. Photograph © Francisco Verenciano.

sequencing. Three weeks later, the result came back as a 98.67% match on GenBank to a sequence named as *Gerhardtia borealis* MH270627. Checks were done against this species using books and articles (Vizzini *et al*, 2015; Endo *et al*, 2021) and it seemed to match very closely. As *Lyophyllum boreale* is one of the obsolete names given to this species, we had not been far off in our initial thinking.

Gerhardtia is a saprotrophic genus in the family *Lyophyllaceae*, order *Agaricales,* phylum *Basidiomycota*. Most of the records of this species are specimens from Scandinavian countries.

In retrospect, without DNA sequencing and for a group of amateur mycologists like us, the identification would most likely have been left as *Lyophyllum* sp. In the past, there have been similar occurrences where, even after hours of microscopy and research, it has not been possible to classify a mushroom further than its genus. In this particular case, the genus *Gerhardtia* was not included in most of our books.

Looking in our library, it looks like only *Funga Nordica* (Kalamees, 2012) and *Fungi of Temperate Europe* (Læssøe & Petersen, 2019) have included it (the latter under the synonym of *Gerhardtia incarnatobrunnea*).

As *Gerhardtia borealis* is not listed in any of the taxonomic updates to the GB&I Fungus checklists, including the British Mycological Society database (FRDBI-Fungal Records database of Britain and Ireland), the Natural History Museum's UK Species inventory or RGB Kew's Basidiomycete checklist/fungarium, we concluded this was a new species to Britain.

Geoffrey Kibby and Martyn Ainsworth, who

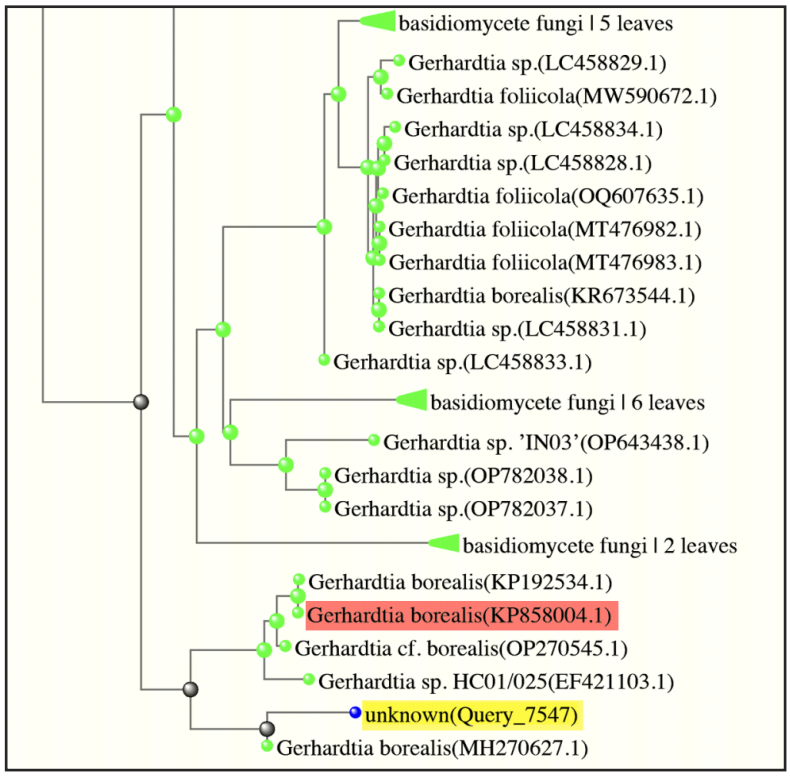

Fig. 5. Part of a phylogenetic tree produced by GenBank showing the potential new species highlghted in yellow. The sequence of *G. borealis* included in Vizzini *et al*. 2015 is shown in red.

had been helping us with the identification, spent some time looking at the DNA sequence, running it through GenBank (public database of DNA sequences) and drawing the phylogenetic (evolutionary relationships of species) tree (Fig. 5). The plot thickens when these experts came to the conclusion that although our collection is undoubtedly new to Britain, it is at the same time unlikely to be *G. borealis* as defined in Vizzini *et al*. (2015). The sequence that our specimen agrees with was recorded as *G. borealis*, but it was taken from a root tip extraction (not fruitbody) collected in Russia, *Gerhardtia borealis* isolate 382, GB MH270627. It probably represents a new undescribed *Gerhardtia* species. We also sent the sequence to Vizzini and he also was of the opinion that it was not the same as *G. borealis* as sequenced in Vizzini *et al*. (GenBank KP858004.1) but probably a new species.

Gerhardtia borealis is very probably one of a species complex (a group of closely related but distinct species). We are currently pursuing several avenues to try to determine if it has been described elsewhere or to perhaps describe it as new, but it will most likely be a long journey. We would ask that if anybody finds any specimens of the genus *Gerhardtia*, to let us know, so we can work together.

Acknowledgments

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