Field Mycology

Volume 24 (4) November 2023

Published by the British Mycological Society

Field Mycology

Field Mycology is a quarterly magazine, published by the British Mycological Society. It provides articles about fungi of interest to the field mycologist, covering all aspects of identification, conservation, recording and collection, for all levels of expertise.

EDITORIAL PANEL

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ISSN 2213-6843

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Front cover: *Chroogomphus fulmineus,* a rather common species in the pine woods of the Cairngorms, Scotland and showing the flame red flecks of veil on the stem which give it its name. Photograph © Geoffrey Kibby.

Back cover: *Russula integra,* a common species in Scottish conifer woodlands. See the article on p. 121. Photograph © Mario Tortelli.

EDITORIAL

My thanks to Tony Leech who sent in the photo along with the following note:

All Five Kingdoms

On a recent (2023) Norfolk Fungus Study Group foray to Broadland Country Park near Norwich, Mike Ball took this photo of the myxomycete parasite *Polycephalomyces tomentosus* (the slender white clubs) which is widely recorded in Norfolk. The slime mould was identified as *Trichia favoginea* by Stewart Wright and is the first Norfolk record.

It was commented that this was a slime mould (Kingdom *Protista*), likely feeding on bacteria (Kingdom *Monera*), on wood (Kingdom *Plantae*) parasitised by a fungus (Kingdom *Fungi*) being appreciated by humans (Kingdom *Animalia*).

Polycephalomyces tomentosus sprouting from the surface of the slime mould *Trichia favoginea*. Photograph © Mike Ball.

A possible antidote for Death Cap poisoning

The Death Cap, *Amanita phalloides*, is responsible for the majority of mushroom related fatalities worldwide. Symptoms may appear as soon as six hours after ingestion and include nausea, vomiting and diarrhoea. If a person isn't treated immediately, the toxins can go on to cause liver and kidney damage that can lead to death within 48 hours after ingestion.

In a recent issue of *Nature Communications* (Wang *et al*, 2023), the authors report that in tests on mice and on human cells in lab dishes, a dye already used in medical procedures – indocyanine green – could block the mushroom's alpha-amanitin toxin from causing the damage which often leads to death. Further trials are needed to prove its efficacy in humans.

Wang, B. *et al*. (2023).Identification of indocyanine green as a STT3B inhibitor against mushroom α-amanitin cytotoxicity https://www.nature.com/articles/s41467-023-37714-3

Obituary:
Dr Audrey Sybil Yelland
Dec 1935—October 2022

I first met Audrey in the late 1960s, when I was an undergraduate student at West Ham College of Technology (later to become part of North-East London Polytechnic, then the University of East London), where she taught mycology for the University of London BSc. degree. She was an inspiring teacher, and it was she who introduced me to the worlds of fungi and slime moulds.

She had received her Ph.D. from the University of Southampton in 1964, for a study of host-parasite relationships in *Erysiphe graminis*.

From then to at least the 1970s she was leading fungus forays in Epping Forest, for students and for members of the BMS and, I believe, the Essex Field Club.

After retirement she moved to a cottage called "Bandit's Retreat" near Mitcheldean in the Forest of Dean.

She was an active (founder) member of the Dean Fungus Group and added over 1700 records to the group's database between 1987 and 1992. It is said that she was always happy to share her knowledge, and could often be seen rummaging in a hedge bottom while smoking a cigarette. (Val & Keith Davies: "We bought our first microscope from Audrey and had some tuition from her. She didn't suffer fools gladly! She could be grumpy but had a sense of humour.").

By the time I moved to the Dean in 2014, she was living in a retirement home and had become something of a recluse. She died on 27th October 2022, age 86, at Longhope Manor Residential Home, Longhope, leaving no known surviving relatives.

John Holden

Fungal Portrait: 96
Xerocomellus cisalpinus and some lookalikes

Geoffrey Kibby

Fig. 1. *Xerocomellus cisalpinus,* Epping Forest, Essex, September 2022. Note the intense blue staining in the cut flesh of the specimen at left. Photograph © Geoffrey Kibby.

Xerocomellus cisalpinus Simonini, H. Ladurner & Peintner was described in 2003 (as *Xerocomus*) and first recorded in Britain a year later. The specific epithet *cisalpinus* means 'on this side of the Alps', as the holotype and paratypes were all found on the Italian (south) side but is a misnomer as the species is common throughout much of Europe. In my experience it is the commonest *Xerocomellus* in many parts of southern England, usually associated with *Quercus* but recorded with other deciduous host trees also.

Good field characters when fresh and young are the bright two-toned yellow and red stem, the often cracking cap, frequently with reddish tones in the cracks and in particular the intense blue staining of the stem when scratched (Fig. 1). Identification of old, faded specimens of *Xerocomellus* species should rarely be attempted as they all look very similar with age.

Microscopically it has spores 11.5–15.0 x 4.5–5.7 µm, with very faint longitudinal lines or ridges, but these are difficult to see with a light microscope unless you have extremely high quality lenses.

Very similar in its strongly staining flesh and striated spores is *X. ripariellus* (Fig. 2), but this has a bright blood-red, cracked cap and prefers wetter woodlands, often around pond edges, boggy areas, etc, with a variety of tree species but especially *Salix*, *Alnus* and sometimes *Quercus*.

Xerocomellus chrysenteron (Fig. 3), the so-called red-cracked bolete is illustrated in most field guides but in Britain at least is much less common than *X. cisalpinus* and prefers either conifers or *Fagus* as its hosts. Its stem is usually more uniformly red and its flesh rarely bruises intense blue, more frequently being a dull red in

Fig. 2. *X. ripariellus* prefers wet, boggy areas with *Salix*. New Forest, Hampshire, 2018. Photograph © Geoffrey Kibby.

Fig. 3. *X. chrysenteron* showing its reddish flesh in the stem. Photograph © Geoffrey Kibby.

the stem. Its spores are not striated and broader (11.8–16.5 x 4.8–6.8 µm) than those of *X. cisalpinus*.

As the season progresses into late autumn another species begins to make an appearance: *X. pruinatus* (Fig. 4). This species often does not crack and has a dark, plum-red to dark blackish brown cap, usually with a distinct, thin red marginal zone. The stem varies from clear yellow to reddish with age, often with copious mycelial threads at its base and its flesh is pale to bright yellow flushing slowly pale blue in the stem. Its spores are faintly striated. Its preferred host is *Fagus*.

These four species have all undoubtedly been much confused in the past and formed part of the composite 'Red-cracked Bolete' illustrated in so many books. With careful attention to field characters, and microscopy if possible, they can usually be successfully distin-

Fig. 4. *X. pruinatus* showing the narrow red band around the cap margin, the yellow, poorly staining flesh and copious mycelial threads at the stem base. Photograph © Mario Tortelli.

Entoloma jennyae new to Great Britain

Pauline Penna*

Goss Moor NNR in mid Cornwall sits within a wide shallow valley which gives rise to the source of the River Fal. Despite having suffered the ravages of 800 years of tin streaming, followed by gravel and sand extraction in the 20th century, it now provides a rich mosaic of lowland heath and wetland habitats.

A visit with the Cornwall BSBI group in August, 2023 was sure to reveal some interesting plant species and possibly some fungi. Within a short period of time a youngster in the group had discovered a "large blue, pink-gilled mushroom" amongst low growing Western Gorse and heathers. A search of the area revealed several clusters, 20 sporocarps in all. *Entoloma bloxamii* s.l. has been recorded in several areas in Cornwall, but having read about the sequencing and taxonomic division of this group in *Field Mycology* (Ainsworth *et al.* 2018) it seemed reasonable to collect a sample for identification.

This study looked at the *E. bloxamii* group, which had long been considered to be a species complex. DNA sequencing and phylogenetic analysis was carried out on 32 dried specimens of *E. bloxamii* s.l. Together with the morphological examination this demonstrated four distinct species: *E. bloxamii*, *E. madidum*, *E. atromadidum* and *E. ochreoprunuloides* (now assigned to the earlier name *E. luteobasis* following Brandrud *et al.* 2020) together with a possible fifth species from Lancashire.

It soon became apparent that the morphology of the specimen from Goss Moor (Figs 1 & 2) did not fit any of the above species. They all have isodiametric spores and coloured stipes, unlike this specimen with heterodiametric spores and a white stipe. Several keys were tried but provided no answers, a slow flick through the pages of a book can be very calming! As has happened in the past, *Mushrooms and Toadstools of Britain and Europe* (Kibby, 2023) provided an answer in

Fig. 1. *Entoloma jennyae* showing the bluish lilac, radially rugulose surface. Goss Moor NNR, Cornwall, 15 August, 2023. Photograph © Pauline Penna.

Fig. 2. *Entoloma jennyae* showing the broad, widely spaced gills and white stem. Photograph © Pauline Penna.

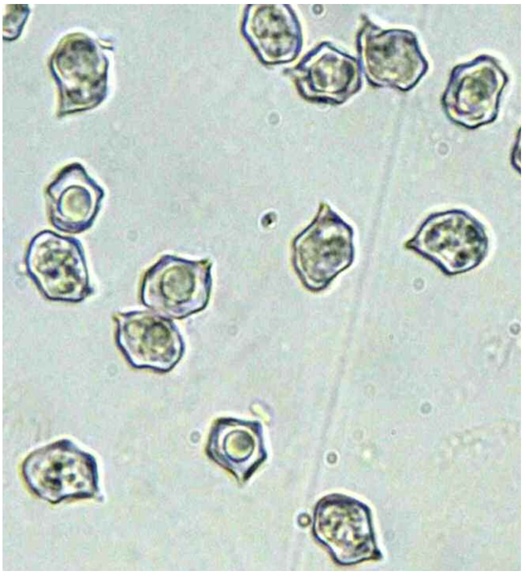

Fig. 3. Spores of *E. jennyae* showing their irregular, elongate shape (heterodiametric`) with 5–6 angles. Photograph © Pauline Penna.

Volume 4: *Entoloma jennyae* Noordel. and Ten Cate. This looks like another 'big blue pinkgill' but with a white stipe. This beautiful species was described 30 years ago from two collections found by a visiting group of Dutch mycologists in an Irish bog in County Galway, and had never been seen again by anyone, anywhere.

Fig. 4. Swollen, balloon-like cells from the cap cuticle. Photograph © Pauline Penna.

Description of Goss Moor specimen

Cap 60 mm lilaceous blue, rugulose, centrally depressed; margin lobed; drying greyish blue.
Gills cream becoming pink with spores. Widely spaced, broad, edges wavy, adnexed.
Stem white, fibrous, cylindrical 40 x 10 mm.

Microscopy

Spores heterodiametrical 8–10 x 8 µm, 5–6 angles. Average 9 x 8 µm (Fig. 3).
Basidia 4-spored.
Cheilocystidia and pleurocystidia not seen.
Cap cuticle a trichoderm with swollen terminal cells 40 x 26 µm, some with a papilla (Fig. 4).

It becomes clear that each 'big blue pinkgill' now requires careful examination to determine the species. Many of the older Cornish records should become *E. bloxamii* sensu lato but after the discovery of *E. jennyae* this makes some of those records questionable.

Acknowledgements

Thanks go to Dr Martyn Ainsworth at Kew for confirming the identification, to Eddie Annear for finding the specimens and to Geoffrey Kibby for including in his volumes cryptic species which might just turn up in the UK.

Editor's note:
Postscript received from Pauline Penna

I looked at the records for *E. bloxamii* s.l. on the Cornish database ERICA. There are 6 records, four of these are from different areas of Bodmin Moor. Three from Ken Preston-Mafham state 'grey cap, white stipe'. I have one record from the moor, four blue-grey caps with white stipes, heterodiametric spores, trichoderm with some end cells papillate. I have attached Ken's photo of one of his records (Fig. 5), the first of which was in 2011, on Lady Down; he counted 30 specimens.

One of the two other records was mine from Greenamor, an area of alkaline, culm measures in North Cornwall. This lone specimen had a blue cap, blue stipe and isodiametric spores. Sadly there is no photo or voucher to confirm which of the species of the *E. bloxamii* group it was. The same is true of the other record by Barry Candy from Rosemullion Head, another alkaline outcrop on the South coast.

I assume from this that *E. jennyae* occurs on the acidic moorland of Cornwall, sometimes fruiting in large numbers. Some species of the *E. bloxamii* s.l. group may be found in areas of alkaline soils but careful examination will be needed to determine which species they actually are.

* paulinepenna13@gmail.com

References

Ainsworth, M.A., Douglas,B., Suz, L.M. (2018). Big Blue Pinkgills formerly known as *Entoloma bloxamii* in Britain: *E. bloxamii* s.str., *E. madidum*, *E. ochreoprunuloides* forma *hyacinthinum* and *E. atromadidum* sp.nov. *Field Mycol*. 19(1): 5–14.

Brandrud, T.E. *et al*. (2020). On some new or little known *Entoloma* species (*Tricholomatinae*, *Basidiomycota*) from Norway. *Agarica* 39: 31–52.

Kibby, G. (2023). *Mushrooms and Toadstools of Britain and Europe* Vol 4. Privately publ. fieldmycol@yahoo.co.uk

Noordeloos, M.E. (1994). Studies in *Entoloma* 14. Some new species and records. *Ost. Zeitschr. f. Pilzk*. 3: 29–31.

Fig. 5. *E. jennyae* on acid soils on Bodmin Moor, Cornwall. Photograph © Ken Preston-Mafham.

Smuts on the water: the British status of *Tracya hydrocharidis* and a report of *T. lemnae*, new to Britain

A. Martyn Ainsworth*

The two smut fungi named in the title of this article represent the entire contents of the genus *Tracya*, which was named after the American botanist and mycologist Samuel Mills Tracy. These species are characterised by producing lesions (sori) containing clustered or scattered brown spore balls embedded in the floating leaf blades and/or petioles of aquatic monocotyledonous plants, specifically of *Hydrocharis morsus-ranae*, Frogbit and of *Spirodela polyrhiza*, Greater Duckweed. These plants share a very peculiar lifestyle. In early autumn their floating fronds begin to senesce and disintegrate before the remaining part, the turion, sinks to the bottom of the water and lies dormant throughout the winter. The turions rise to the surface again in spring as they start to grow new floating leaves. In the case of *H. morsus-ranae*, these give the plant the appearance of a miniature water lily (Fig. 1). *Spirodela polyrhiza* has much smaller fronds (Fig. 1) although it is the largest of our duckweeds and, as its epithet suggests, each frond has several roots projecting from its lower surface. For conservation purposes, *H. morsus-ranae* is currently assessed as Vulnerable in England and in Great Britain, whereas *S. polyrhiza* is a more common plant that is officially classified as being of Least Concern (JNCC, 2023). *Hydrocharis* often grows in the company of *Spirodela* (Fig. 1) and both species show a predominantly southern distribution in Britain with few or no records from the counties of northern England and Scotland. The spore balls of the two species of *Tracya* are so similar when examined under the microscope, that the smuts are keyed out simply

Fig. 1. Smut-free examples of the two British floating aquatic plants that can host *Tracya*, showing (left) a heart-shaped leaf of *Hydrocharis morsus-ranae* and (right) a small colony of *Spirodela polyrhiza*. Scale bar represents 5 mm. Photograph © Martyn Ainsworth.

by identification of the two host plants. Here it should be mentioned that Klenke & Scholler (2015) reported that *T. lemnae* is also rarely found in Germany on the much smaller duckweed *Lemna minor*. Furthermore, Vánky (1994) cautioned that the two smuts may turn out be conspecific, a hypothesis that, judging from the lack of sequences deposited in GenBank, seems not to have been tested by DNA barcode analysis at the time of writing (hint, hint!).

The British status of *Tracya hydrocharidis* Frogbit Smut

Tracya hydrocharidis, Frogbit Smut (BMS, 2022) is one of those unusual fungi that was added to the British and Irish list based not on a deliberately collected specimen or a record made in the field, but on a careful examination of preserved specimens of its host plant in the Kew Herbarium. Its spore-producing sori were found, albeit extremely sparsely, in a single dried Frogbit leaf collected in Runnymede, Surrey, in July 1937 and in another such leaf collected near Sand Lough, Co. Fermanagh, in July 1948 (Spooner & Legon, 2006). Nick Legon subsequently refound the smut at the Surrey site (Langham Pond) in July 2005 and he was then followed by the present author who collected it there in May 2009. Based on its single known English site, *T. hydrocharidis* was assessed for conservation purposes in Great Britain as CR (Critically Endangered) in the unofficial assessment of Evans *et al.* (2006). It also led to its inclusion on the Sect. 41 list of "priority species" in England which, in turn, led to a series of surveys (2009–2012) organised by Plantlife and Natural England's Species Recovery Programme (SRP). These were devised to investigate English populations of the host plant to try to build a better picture of this poorly known smut's national distribution and thereby arrive at a more informed assessment of its extinction risk.

The dedicated SRP surveys generated *T. hydrocharidis* records from an additional seven vice counties in England (see list of vouchers below), thereby indicating that this smut's provisional Critically Endangered status should be reassessed. I estimate that 145 host plant populations were surveyed, of which around one third were infected with *Tracya*. However, as is usual with rust and smut surveys, individual sites varied greatly in the proportion of visibly

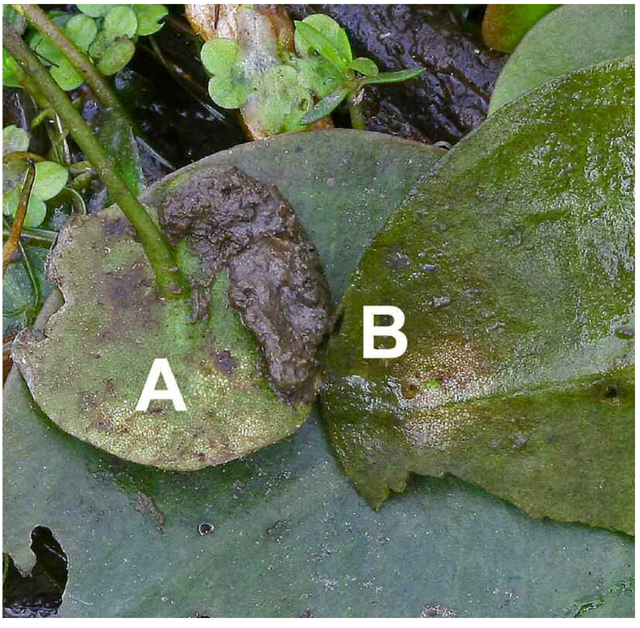

Fig. 2. The undersides of two freshly collected *H. morsus-ranae* leaves showing pale patches containing (A) scattered and (B) a discrete cluster of buff coloured immature spore balls of *T. hydrocharidis* (K-M000163435, Surrey, May 2009). Photograph © Martyn Ainsworth.

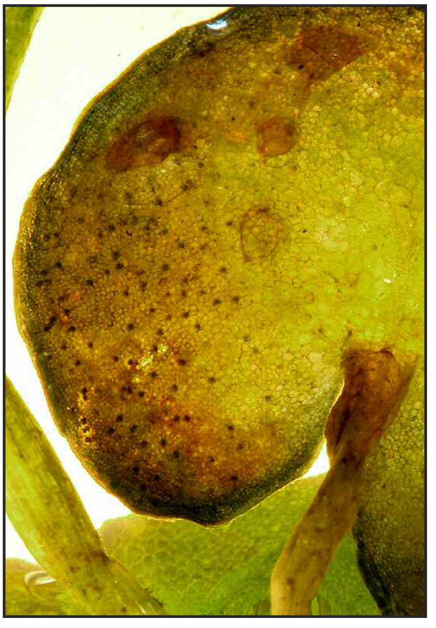

Fig. 3. Backlit leaf of *H. morsus-ranae* mounted in water and containing scattered dark mature spore balls of *T. hydrocharidis* seen in silhouette (K-M000164417, E. Sussex, Sept. 2009). Photograph © Martyn Ainsworth.

infected host populations which ranged from zero to almost 90% (Ot Moor). There was also much variation in the proportion of infected plants within populations of the host. In the SRP survey, the most severely infected host populations were estimated to have 50–60% of visibly infected *Hydrocharis* rosettes. However, it should be borne in mind that the ease with which this fungus can be detected in the field is highly dependent on the date of the site visit. In late spring, *Tracya* hunting is relatively difficult and involves recognising yellowish leaf spots in otherwise sound leaves (Fig. 2) when the embedded spore balls are still very pale. Later in the summer, the older leaves have started senescing and yellowing and frequently have holes and eroded edges. These are the prime targets for the smut surveyor to view with binoculars or, if within reach, to hold up to the light and examine with a hand lens (beware of accidentally observing the sun through the leaf holes!). In my experience, a few well-chosen, partly submerged and yellowed leaves viewed against a bright sky is often all that is necessary to demonstrate the presence of the lead-shot-like mature *Tracya* spore balls (Fig. 3) within an infected population of the host. As autumn progresses and light levels and temperatures fall, the leaves take on a more shredded appearance as they decay and sink. The embedded spore balls are slowly set free from the sinking leaf fragments making smut surveying increasingly difficult towards the end of the year.

Additional specimens determined or confirmed by AMA

Buckinghamshire (VC24): Langley, in the Slough Arm of the Grand Union Canal, OS Grid Ref. TQ00807994, 18 Jun. 2011, coll. & det. A.M. Ainsworth, K-M000170883. Ibid, TQ02198005, 28 Jul. 2012, coll. & det. A.M. Ainsworth, K-M000178225. East Norfolk (VC27): How Hill, in ditch, TG37091937, 20 Sep. 2013, coll. & det. A. McVeigh, K-M000236336. Strumpshaw Fen, in dyke, TG3306, 22 Nov. 2012, coll. & det. T.R. Abrehart, K-M000181025. Ibid, TG3405, 22 Nov. 2012, coll. & det. T.R. Abrehart, K-M000181026. Ibid, TG3406, 22 Nov. 2012, coll. & det. T.R. Abrehart, K-M000181024. Sutton Fen, in dyke, TG37022311, 12 Jul. 2016, coll. & det. A.M. Ainsworth, K-M000206290. Upton Fen, in dyke, TG38641391, 13 Jul. 2016, coll. & det. A.M. Ainsworth, K-M000206306. Wheatfen, in pond, TG3205, 30 Oct. 2012, coll. & det. T.R. Abrehart, K-M000181023. East Suffolk (VC25): Barnby Broad, in dyke, TM47759110, 6 Dec. 2011, coll. & det. T.R. Abrehart, K-M000173891. Carlton Marshes, in dyke, TM50679215, 6 Dec. 2011, coll. & det. T.R. Abrehart, K-M000173895. East Sussex (VC14): East Guldeford Level, in ditch, TQ94092238, 15 Aug. 2011, coll. & det. A.M. Ainsworth, K-M000171637. Hooe Level, in ditch, TQ67020563, 16 Aug. 2010, coll. & det. A.M. Ainsworth, K-M000166863. Lewes, in ditch, TQ41431075, 27 Sep. 2014, coll. & det. A.M. Ainsworth, K-M000194218. Litlington (near), in ditch near Cuckmere River, TQ52010149, 18 Sep. 2009, coll. & det. A.M. Ainsworth, K-M000164417. Pett Level, in ditch, TQ90811517, 18 Sep. 2014, coll. & det. A.M. Ainsworth, K-M000193972. Southease (near), in ditch near River Ouse, TQ428056, 4 Jul. 2014, coll. & det. A.M. Ainsworth, K-M000192709. North Somerset (VC6): Clapton Moor, in rhyne, ST ST4573, 11 Oct. 2010, coll. & det. J.H. Smith, K-M000168022. Tadham Moor, in ditch, ST41974414, 30 Oct. 2011, coll. & det. J.H. Smith, K-M000172871. Weston Moor, in rhyne, ST4473, 11 Oct. 2010, coll. & det. J.H. Smith, K-M000168024. Oxfordshire (VC23): Ot Moor, in ditch, SP5613, 20 Aug. 2012, coll. & det. A. McVeigh, K-M000178925. Ibid, SP5614, 13 Aug. 2012, coll. & det. A. McVeigh, K-M000178927. Ibid, 20 Aug. 2012, K-M000178926. Ibid, SP57201426, 13 Aug. 2012, coll. & det. A. McVeigh, K-M000178928. South Somerset (VC5): Catcott Heath, in rhyne, ST408409, 1 Oct. 2009, coll. & det. N.W. Legon, K-M000166151. North Moor, in rhyne, ST3331, 22 Sep. 2009, coll. & det. N.W. Legon, K-M000166150.

Tracya lemnae, Duckweed Smut, new to Britain

Thus far, surveying duckweed leaves for *Tracya* sori has been far less satisfying than peering at those of backlit Frogbit. Nevertheless, I was eventually rewarded with the sight of a few dark dots within a single well-decayed frond of *Spirodela polyrhiza* when it was viewed through a hand lens against a cloudy sky on a West Sussex ditchside in July 2018. This is the only known British record of *T. lemnae*. Interestingly, and unlike all the spore balls of *T. hydrocharidis* I have examined, those of *T. lemnae* sometimes had a surrounding paler 'halo' when viewed in

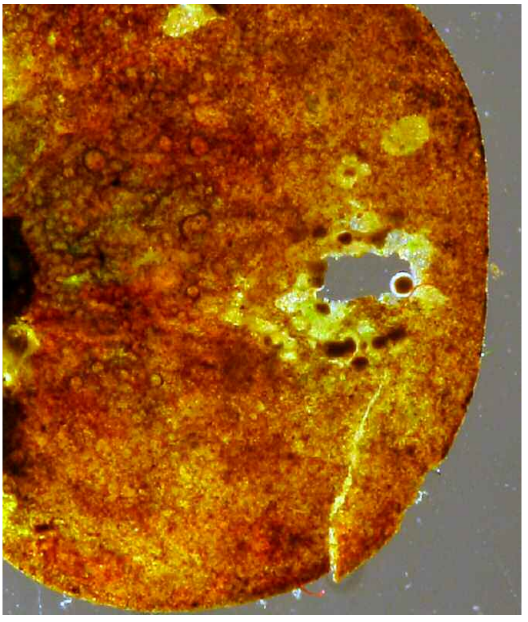

Fig. 4. Backlit leaf of *Spirodela polyrhiza* mounted in water with a few dark mature spore balls of *T. lemnae* still embedded in the leaf tissues surrounding a hole in the leaf. One spore ball can be seen floating freely within the hole itself surrounded by a pale halo of basidia and basidiospores (K-M001441611, W. Sussex, Jul. 2018). Photograph © Martyn Ainsworth.

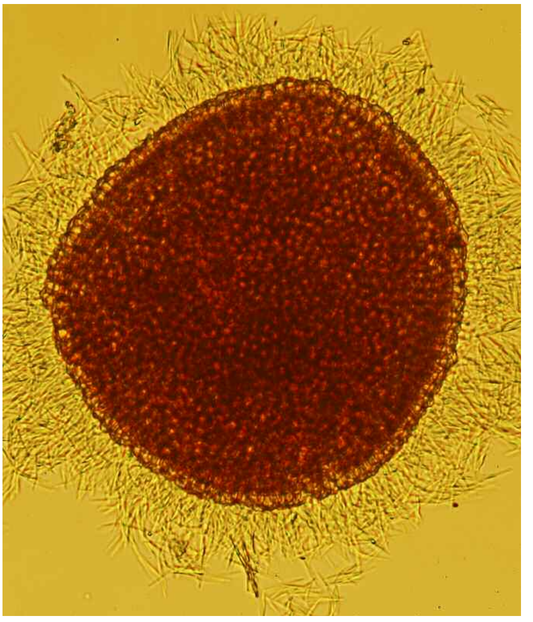

Fig. 5. A brown spore ball of *T. lemnae* mounted in Melzer's reagent. The constituent teliospores have germinated in situ to produce a fringing mass of hyaline basidia and basidiospores (K-M001441611, W. Sussex, Jul. 2018). Micrograph © Martyn Ainsworth.

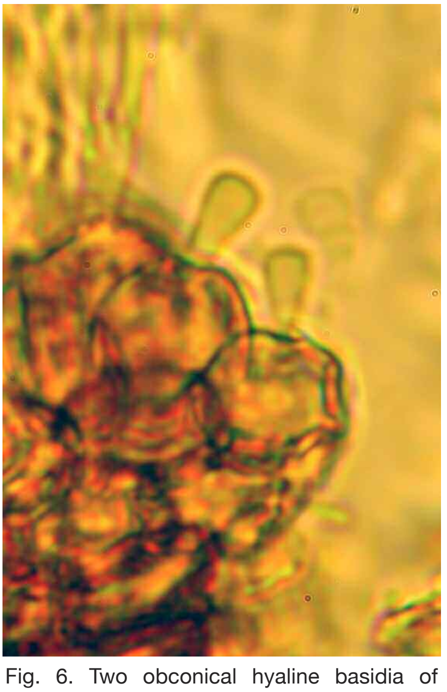

Fig. 6. Two obconical hyaline basidia of *T. lemnae* projecting from brown teliospores on the surface of a spore ball mounted in Melzer's reagent. (K-M001441611, W. Sussex, Jul. 2018). Micrograph © Martyn Ainsworth.

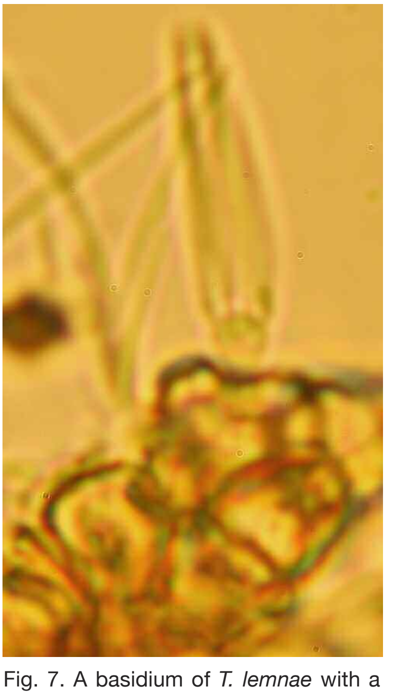

Fig. 7. A basidium of *T. lemnae* with a whorl of developing narrowly fusiform basidiospores on the surface of a spore ball mounted in Melzer's reagent. (K-M001441611, W. Sussex, Jul. 2018). Micrograph © Martyn Ainsworth.

water under the stereo microscope (Fig. 4). The spore balls (Fig. 5) usually measure 60–250 µm in diameter (exceptionally they can be elongated and up to 320 µm long) and comprise a central network of hyphae with a surrounding single layer of firmly united, radially elongated (to 14 µm long), brown teliospores (Vánky, 1994). Teliospores are polygonal in surface view and usually measure 9–14 µm at their widest points. The observed pale 'halo' indicated that the teliospores were germinating in situ to produce underwater basidia (promycelia) which are hyaline, obconical and measure around 7 µm long (Fig. 6). These, in turn, were producing narrow fusiform basidiospores (sporidia) measuring around 25 µm long (Fig. 7). Interestingly, their in situ production in the USA had been documented in the original description of the species (as *Cornuella lemnae*) during the nineteenth century by Setchell (1891). He noted that basidiospores were formed in whorls of 5–7, measured 26 × 2 µm and covered the spore balls in a "bristly mass". Whether this propensity for in situ germination is of any taxonomic significance is a question that must await the discovery of further finds and further microscopic observations. For further photographs of spore balls of this species (and of *T. hydrocharidis*), I recommend Carina Van Steenwinkel's excellent images documenting both smuts' recent discovery in Belgium (Van Steenwinkel *et al.*, 2022).

Specimen examined

West Sussex (VC13): Amberley, in a ditch by the R. Arun, OS Grid Ref. TQ024118, 16 Jul. 2018, coll. & det. A.M. Ainsworth, K-M001441611.

Concluding remarks

Based on the results of the SRP survey work described above, if I am visiting a site with a good Frogbit population in late summer I now expect to find *T. hydrocharidis* in at least some of the fading leaves. Furthermore, I suspect that the conservation status of this smut in Great Britain should be downgraded to mirror that of its host plant (Vulnerable) while that of *T. lemnae* should remain as Data Deficient until we have a more complete picture of its distribution. Sadly, however, there is little incentive to carry out such essential conservation assessment and prioritisation work. This is due to the breakdown and cessation of the official endorsement process for non-lichenised fungal Red Lists for Great Britain which occurred ten years ago just after the officially approved Red List for *Boletaceae* was published in 2013.

Acknowledgements

Thanks to Natural England's Species Recovery Programme Team and to Plantlife for funding much of the fieldwork; thanks to Toby Abrehart, Andy McVeigh and the late Justin Smith for carrying this out and for submitting their reports to NE; and thanks to the numerous landowners, managers and conservationists who provided support, advice, and permission to access and study *Hydrocharis* populations. Thanks are also due to the Esmée Fairbairn Foundation for funding the Lost and Found Fungi project team's 2016 visit to Norfolk and to Sue Rubinstein and Christine & David Hadrill for their help with surveying in Sussex.

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Russula diversity in NE Scotland

Helen Baker*, Andy Taylor**, Toni Watt* & the Grampian Fungus Group

A Citizen-science Project

The Grampian Fungus Group (GFG) has been recording fungi across NE Scotland for nearly 25 years and over that time an impressive list of *Russula* records has been compiled, but there are relatively few recent records for many species. To update our list and improve our identification skills we joined forces with Dr Andy Taylor from the James Hutton Institute (JHI) to embark on a project matching field mycology with DNA sequencing. Grampian Fungus Group members collected and processed specimens during 2019 and 2020, collecting systematic data (based on Geoffrey Kibby's recording sheet, 2012) and photographs, and then drying for DNA sequencing by JHI. In addition, species records from 2021 and 2022, some without DNA verification have also been included.

Our Approach

Specimens for the project were collected on Group and individual forays and were placed individually in plastic pots to minimise contamination; surrounding tree species were recorded in the field. For each specimen, size, colours and textures were recorded, and extent of cap cuticle peel. Taste and smell, and reactions to guaiac and ferrous sulphate, and when relevant potassium hydroxide, were noted. Cap cuticle cell structure was examined in the thin tissue at the edge of a peeled section, stained with Buyck's cresyl blue (*Russula* formulation) and, when judged necessary to aid identification, with carbol fuchsin to highlight fuchsinophile granules. Finally, a section of the cap was set overnight for a spore print to both assess spore colour but also to provide spores for staining with Melzer's solution and examination of spore ornamentation. Remaining cap sections were then dried in a domestic fruit drier for 10 hours at 40°C, following which gill material was separated and stored in plastic tubes ready for DNA extraction. Gill samples from 2019 and 2020 were sequenced at JHI using the whole of the ITS region. Some specimens from 2021 and 2022 were sequenced by Aberystwyth University under the BMS Sequencing Grant after DNA extraction and amplification using the Group's Bento Lab.

Over the two earlier seasons, we dried 171 specimens. After sequencing, we had 140 good sequences and 31 short sequences, some of which were too short to allow definitive identification. An additional 16 whole ITS sequences were obtained from specimens collected in 2021 and 2022. To help determine species identities we copied each sequence into the analysis tool of the UNITE sequence database (https://unite.ut.ee/). This tool produces a list of 'matches' between the query sequence and sequences in the database and gives a measure of how good the matches are, and the length of the coverage between the query sequence and the reference. For most of our specimens we obtained a probable identification, but for some the matches were not as good, with two or more species being possible; these specimens require further assessment. We also checked sequences against those in GenBank as the two databases hold some different sequences, but we cautiously made comparisons only with sequences from voucher specimens (not root or soil extractions) from published research.

Russula Habitats in NE Scotland

The Grampian region is dominated by peats, non-calcareous gleys and brown soils with very little basic soil, leading to mainly acidic woodland types. These include naturally derived birch (*Betula* spp.) and Scots pine (*Pinus sylvestris*) woodlands, and commercial plantations of Scots pine, spruce (*Picea* spp.), larch (*Larix* spp.) and other conifers. However, at highest elevations dwarf Sub-Arctic scrub, comprising a range of willows (*Salix* spp.), occurs, and in lower areas pockets of mixed deciduous woodland with oaks (*Quercus* spp.), aspen (*Populus tremula*), alder (*Alnus glutinosa*), willows, Wych elm (*Ulmus glabra*), hazel (*Corylus avellana*) and beech (*Fagus sylvatica*) are found over brown and alluvial soils. In addition, parkland associated with castles, country houses and urban areas provide a wider range of tree species, including lime (*Tilia* spp.). Along the coasts, conifer plantations occur in some areas, mainly of various pine species (*Pinus* spp.), and mixed scrub is found in dune slacks, which includes willow, birch, hazel and alder. With the exception of high elevation dwarf woodland, all of these habitats were explored for the project.

Russula Species

From the DNA sequences we confirmed records for 54 species of *Russula* (Table 1), with an additional six species identified from macro and micro characteristics (denoted as non-sequenced in Table 1) giving a total over the four years of 60 species. Notable records for our region are described briefly below.

A comparison between species determinations from morphology and chemical tests with those from DNA determination revealed that about 74% (108 of 146 specimens) of morphological determinations were correct, demonstrating the effectiveness of the main keys we used (Kibby 2012 and Knudsen & Vesterholt 2012) and the importance of collecting good data on microscopic features, including effective use of carbol fuchsin for staining pileocystidia in the cap cuticle. Species determinations for a further 12 specimens based on morphological characteristics were not conclusive, and specimens with short DNA sequences (<150 bp) were excluded. However, there were some interesting errors in our determinations and findings, and some of these are described below within the species notes and under 'Difficulties with *Russula* Identifications'.

Notable Species Records for NE Scotland

Russula violaceoincarnata Knudsen & T. Borgen (Fig. 1)

A single specimen[1] was found growing under silver birch (*Betula pendula*) at Wood of Delgaty, Turriff (NJ7550) on 31 August 2019. The specimen wasn't identified prior to DNA sequencing and no voucher material has survived, but this represents only the second British record for this species following the collection reported by Mario Tortelli (2020) in Abernethy. A specimen collected from birch woodland in the Forest of Birse (NO5891) on 18/09/2021, yielded a moderate length ITS sequence that also matched this species.

Russula vinososordida Ruots. & Vauras (Fig. 2)

Two specimens were collected from under birch at two different locations; Muir of Dinnet, Aboyne (NO4499) on 24 August 2019[2], and Morrone Birkwood, Braemar (NO1490) on 17 August 2020[3]. There are four other confirmed British records for this species in the FRDBI (accessed 27/08/23), but it could be more frequent in Scotland due to its association with birch and possible confusion with *R. vinosa*.

Russula renidens Ruots. *et al.*

A specimen was collected from under birch at Haughton Country Park, Alford (NJ5616) on 14 September 2019, but tentatively identified as *R. persicina* due to near-adnate cuticle peel and very acrid taste. The DNA sequence from the specimen was a good match for *R. renidens* in UNITE (UDB015975, *Russula renidens*, Estonia, collected by Jukka Vauras, 2001, with length 660bp, coverage 11-660 and similarity 97%). There are just six other certain records and three likely records in the FRDBI (last 50 years) for this species in the UK.

Russula intermedia P. Karst

Three specimens from two locations were recorded for this distinctive birch associated species; Crathes Castle, Banchory (NO7396), 26 August 2020, and Dinnet, Aboyne (NO4698), 12 September 2020. Another specimen was collected from Haughton Country Park, Alford (NJ5616), on 2 September 2021, again from under birch, but not sequenced. The spores of this species are globose to sub-globose and reticulated, which is

[1] This specimen matched UNITE sequence UDB016635, *Russula violaceoincarnata*, Finland (collected by Katri Kokkonen and Jukka Vauras, 2007), with length 556bp, coverage 12-556, and similarity 99%.

[2] Specimen matched UNITE sequence UDB011301, *Russula vinososordida*, Estonia (collected by Jukka Vauras, 2011), with length 671bp, coverage 4-671 and similarity 99%.

[3] This specimen also matched UNITE sequence UDB011301, with length 632bp, coverage 1-632 and similarity 99%.

unusual in *Russula* and makes identification relatively easy (Fig. 3). There are 31 other records in the FRDBI (last 50 years), with notable clusters in Perthshire, Deeside and Cumbria, but it's possible that this is an under-recorded species in northern birch woods and it could be much more widespread.

Russula pelargonia Niolle

A challenging species to separate from *R. violacea* and both are rare in the UK making it difficult to develop familiarity. Kibby (2017) suggests that the main differences between the species are slow, dark blue guaiac reaction, pileocystidia 1-2 septate and partially reticulated spores in *R. pelargonia* versus rapid azure blue guaiac, pileocystidia 0-4 septate and spores with isolated warts in *R. violacea*. A specimen was collected from under aspen at Muir of Dinnet, August 2019. Its reaction to guaiac was rapidly mid green-blue, it had long, cylindrical, non-septate pileocystidia and long spore warts with some connectives. Unsurprisingly, whilst we considered this specimen to be more likely to be *R. pelargonia*, our identification was uncertain and it was good to get confirmation via DNA sequencing (matching UDB016031, *Russula pelargonia*, Finland, collected by Jukka Vauras, 2000, with length 653bp, coverage 14-653, similarity 100%). A collection of three specimens from under birch in Haughton Country Park, Alford, on 02/09/2021, was unusual in being large, robust and brown, but having a strong pelargonium smell, and were not identified from morphology. Their spores had isolated warts and all had strong, rapid reactions to guaiac, which suggested *R. violacea*. A good sequence was obtained from one of these specimens, which was also very similar to the above reference sequence UDB016031 (length 652bp, coverage 10-659, 98.6%). Specimens closely matching the morphology of this species were also found in 2022 from aspen woodland at Crathie, Ballater (NO2694), and in 2023 from a different area of birch woodland at Haughton Country Park, Alford, but neither has been sequenced. Whilst there are nearly 50 records in the FRDBI (last 50 years), there were just seven in Scotland prior to these four GFG records.

Russula amethystina Quél.

We now have records of this species from five locations in the region, with three confirmed through DNA analysis, all associated with spruce. The species is very like *R. turci*, which also occurs in the region under Scots pine. We found that spore ornamentation wasn't sufficiently and consistently different between the two species to be reliable for separation. The reaction to guaiac in our *R. amethystina* specimens was more consistently darker blue than in *R. turci*, in which some specimens were completely negative, but this was again inconsistent (Sarnari 2005 suggests neither species has a strong reaction to guaiac; Kibby, 2017, suggests the opposite guaiac reactions). The only consistent characteristics appeared to be habitat association and a tendency for cap colour in *R.*

Fig. 1. *Russula violaceoincarnata* growing in association with *Betula*, Delgaty, Turriff, Scotland, August 2019. Photograph © Toni Watt.

Fig. 2. *Russula vinososordida* growing in association with *Betula*, Morrone Birkwood, Braemar, Scotland, August 2020. Photograph © Helen Baker.

amethystina to be purple-toned and in *R. turci* to be red-brown. There are only five other 'certain' records for *R. amethystina* in the FRDBI (last 50 years), and one of these is a more recent record for one location, but it's possible that this species may be more common in the UK in mature spruce forests and mixed woodland where mature spruce is present.

Russula curtipes F.H. Møller & Jul. Schaeff.
A beech associate, this distinctive species was found in seven locations, five confirmed through DNA analysis. There are just seventeen other Scottish records in the FRDBI (50 years), and only one from NE Scotland prior to the GFG records, but the species is much more frequent in England. It is very likely that this is an under-recorded species in Scotland.

Difficulties with *Russula* identifications

It is well known that whilst cap and stem colour can be a very useful characters for identification of *Russula*, not only do some species show a wide range of cap colours, not all of which are shown in the literature, but cap pigments can wash out. Taste and smell can also be useful additional characters, but both can vary within species and some recorders will be limited by their own sensory ability. However, having at least a reliable taste for a specimen can help place it within a particular section of the genus and narrow identification possibilities.

Spore colour determined from a good spore print is one of the most useful, perhaps critical, characters for identification and appeared to vary little within the species where we had several specimens for comparison. This is where collecting 'good' specimens is important; immature (cap not fully extended) or over-mature specimens will not give good spore prints. Spore ornamentation (observed at x1000 under oil immersion) is also an important character. However, some species, for example *Russula integra*, can have very variable spore ornamentation, which might not be fully described in keys. Some species descriptions, for example those by Romagnesi (1967) and Sarnari (1998 & 2005), include illustrations of spore variations and are extremely useful reference resources. Observation of cap cuticle cell structure is extremely helpful and staining of cap cuticle preparations with carbol fuchsin (CF) or sulpho-vanillin can be essential. CF is not easy to use because of the need to wash with hydrochloric acid, but is accessible and with practice is incredibly useful. Some of our early collections were not stained with CF and this limited species determinations and caused some errors in identifications.

One of the outcomes from the DNA sequencing has been to improve our knowledge of several difficult 'pairings' of commoner species:
Russula puellaris and *R. versicolor* are very similar species and share yellowing in the stem typical of the subsection *Puellarinae*. Kibby (2017) suggests that size, taste, spore ornamentation and the pileocystidia are useful ways to separate these species. Of six specimens collected, we identified just one as *R. puellaris*,

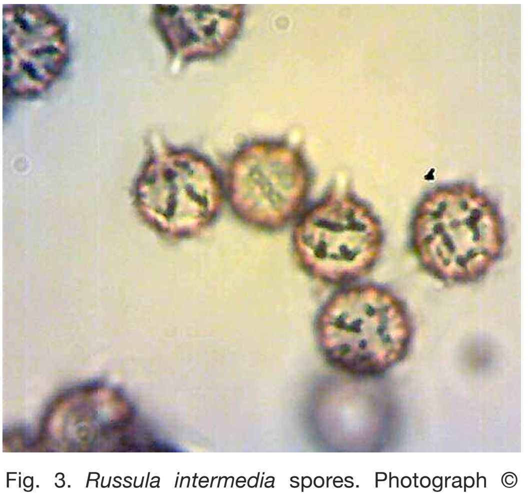

Fig. 3. *Russula intermedia* spores. Photograph © Helen Baker.

Fig. 4. *Russula pelargonia* found growing in association with *Betula*, Haughton Country Park, Alford, Scotland, September 2021. Stem blue with guaiac staining on left and pink with iron sulphate to right. Photograph © Helen Baker.

Fig. 5. *Russula pelargonia* in association with *Betula*, Haughton Country Park, Alford, Scotland, August 2023. © Helen Baker.

Fig. 6. *Russula amethystina* group growing in association with *Picea*, Bin Forest, Huntly, Scotland, August 2020. Photograph © Helen Baker.

based on 0-1 septate, clavate pileocystidia and mild taste, but this proved erroneous and all were *R. versicolor* on DNA analysis. There are plenty of records for these species in FRDBI and NBN Atlas, but *R. puellaris* appears twice as common as *R. versicolor*; DNA analysis in our region suggests that this may not be the case, but a larger sample would be helpful, collected over several seasons, to be sure of comparative frequency.

Another interesting pairing is *R. nitida* and *R. robertii*, which are very similar. We collected five specimens of *R. nitida* and just one of *R. robertii*; from this small sample the consistent differences were spore colour and ornamentation, and habitat, with *R. robertii* probably occurring only in very wet birch woodland, such as on the edges of mires. Stem colour of *R. nitida* varied from wholly white to fully pink so a white or slightly pink-flushed stem wasn't reliably indicative of *R. robertii*. In addition, the pileocystidia in *R. nitida* were variable with some having few septa and thus more like those observed and described for *R. robertii*.

Twenty-three of our sequences were determined as *R. integra* using UNITE and most were initially identified as this highly variable species, but several were misidentified. Three of them were identified as *R. melitodes* (2) and *R. romellii*

(1) primarily on an ecological basis as all three were associated with beech. Interestingly, the genetic variation in all 23 sequences was extremely small. The three specimens from beech woodland raise an interesting possibility that *R. integra* is not just a pine/conifer specialist.

Eight of our sequences matched *R. aquosa*, although three were short (<150 bp compared with >600 bp for most specimens), but we had misidentified three of them: one as *R. emetica*, another as *R. sylvestris* and the third as *R. fragilis*. One of the causes of confusion for these similar species within the sub-section *Russula* related to habitat and all three misidentifications were of specimens collected from relatively dry mixed woodland with birch present, suggesting *R. aquosa* is not restricted to wet habitats. One feature mentioned in keys is taste, but our specimens ranged from mild to very acrid, which led to some of the misidentifications. Spore colour was off-white (Romagnesi code Ib-IIa or B in Kibby 2012) in all but one specimen, which had a white (Ia or A) spore print; this might be a useful character to help separate *R. aquosa* from very similar species within the sub-section *Russula*. *R. aquosa* is, however, typically a dusky pink colour giving it a certain look, which with increased familiarity helps separation from washed out similar species.

Section *Xerampelinae* taxonomy is well known to be challenging and DNA sequences in our collection provided some surprises, including finding apparent *Russula amoenoides* in association with Scots pine and birch/willow, and *R. xerampelina* lacking any red colouring in the stem, and with dark red-brown cap colours superficially resembling *R. favrei*. We now have three ITS sequences from apparent *R. amoenoides*, but it is possible that these are a different species and more work needs to be done to assess the phylogenetic relationships between our specimens and others within the section. Amongst specimens collected in deciduous woodland, there seemed little consistency in identification characteristics, as shown by Adamčik *et al.* (2016). Of seven specimens, five matched *R. nuoljae* and two, with only moderate length sequences (c. 320–390 bp), had matches with both *R. nuoljae* and *R. clavipes* sequences in UNITE. One of these latter specimens had all micro-characteristics consistent with *R. nuoljae*, as described by Adamčik *et al.* (2016), and was associated with *Betula*, whilst the other had spore ornamentation like *R. clavipes*. The keying out of *Xerampelinae* on morphological characters remains problematic, but the key in Adamčik *et al.* (2016) provides the best approach, critically requiring careful processing of the cap cuticle to observe cell morphology at different locations in the pileus. However, our sequences suggest that *R. nuoljae* is frequent or common in our region, most closely associated with birch, including in lowland woods. It was first recognised as British in 2020, after a collection from Abernethy was sequenced, and is illustrated among the addenda in Kibby, Vol. 4 (2023).

Missing Species and Future Recording

Historical records for Grampian are available from several sources: the FRDBI and the North-East Scotland Biological Recording Centre (NESBReC) are the primary sources (GFG records are provided to NESBReC after verification), but additional information is available from the NBN Atlas, and from publications. Exploration of these records shows that another 28 species of *Russula* have been recorded in the region, although not all records are verified, which suggests that about half of all British species may be present.

The project fulfilled its aims to improve knowledge of *Russula* species in our region and increase confidence in processing and identification, although there is still much to learn. In future, we hope to use DNA sequencing in a selective way to confirm identification of interesting specimens for which the morphological approach leaves significant doubt, but this will depend on funding availability.

Table 1. A full list of *Russula* species recorded between 2019 and 2021 in the Grampian region (ns = no DNA sequence), arranged according to the classification adopted by Sarnari (1998).

Subgenus *Compactae*
Section *Compactae*
Russula nigricans
Russula anthracina
Russula albonigra
Russula adusta
Russula densifolia

Section *Lactarioides*
Russula chloroides

Subgenus *Ingratula*
Section *Ingratae*
Russula foetens
Russula illota
Russula laurocerasi
Russula recondita
Russula amoenolens
Russula fellea

Subgenus *Heterophyllidia*
Section *Heterophyllae*
Subsection *Cyanoxanthinae*
Russula cyanoxantha
Subsection *Heterophyllae*
Russula vesca
Subsection *Griseinae*
Russula parazurea
Russula ionochlora
Russula grisea
Russula medullata (ns)
Russula aeruginea

Subgenus *Russula*
Section *Russula*
Subsection *Russula*
Russula atropurpurea
Russual aquosa
Russula fragilis
Russula laccata
Russula betularum
Russula emetica
Russula mairei
Subsection *Violaceinae*
Russula pelargonia
Subsection *Sardoninae*
Russula sanguinaria
Russula sardonia (including forma *viridis* and forma *mellina*)
Russula queletii
Russula gracillima
Russula renidens
Subsection Urentes
Russula badia (ns)
Russula intermedia
Section *Viscidinae*
Russula ochroleuca
Section *Polychromae*
Subsection *Xerampelinae**
Russula xerampelina
Russula cf *amoenoides*
Russula graveolens
Russula nuoljae
Russula clavipes
Subsection Integriforminae
Russula decolorans
Russula vinososordida
Russula paludosa
Russula romellii
Russula curtipes
Russula velenovskyi
Russula violaceoincarnata
Section *Paraincrustatae*
Subsection *Integrae*
Russula integra
Section *Tenellae*
Subsection *Puellarinae*
Russula versicolor
Subsection *Laricinae*
Russula cessans
Subsection *Betulinae*
Russula brunneoviolacea
Russula robertii
Russula nitida
Section *Amethystinae*
Subsection *Amethystinae*
Russula turci
Russula amethystina
Subsection *Chamaeleontinae*
Russula acetolens (ns)
Russula risigallina (ns)
Subsection *Integroidinae*
Russula vinosa (ns)
Russula claroflava (ns)
Russula caerulea

**Xerampelinae* – see text.

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Puccinia ferruginosa, a second rust on *Artemisia vulgaris* in Britain

Chris D. Preston*, David J. Harries**, Julia Kruse*** & R. Nigel Stringer****

On 8 August 2022 C.D.P. decided to take advantage of the newly opened Soham railway station to spend a day recording in that vicinity, as part of a continuing study of the plant parasitic microfungi of Cambridgeshire. During the course of the day he collected a rust growing on *Artemisia vulgaris* (Mugwort) at the edge of a maize field between Little Bank Drove and Soham Lode, Soham. When this material was examined microscopically, it was found to lack urediniospores (II) and consisted entirely of telia with teliospores (III). Initial identification using Termorshuizen & Swertz (2011) suggested that it might be *Puccinia ferruginosa* P. Syd. & Syd., a microcyclic rust which produces only teliospores. This identification was supported by the close resemblance of the rust to the photograph of *P. ferruginosa* from central Europe on the Phytoparasitische Kleinpilze website (www.phytoparasiten.de). This species has long been regarded as distinct from the species currently known in Britain as *P. tanaceti*, a hemicyclic rust with both urediniospores and teliospores and one which is commonly found on *A. vulgaris* in Cambridgeshire, as elsewhere in Britain. As *P. ferruginosa* has not hitherto been recorded from Britain, C.D.P. sent some of his material to R.N.S. His morphological study showed that the Soham rust, though otherwise similar to *P. ferruginosa*, had larger teliospores than those described for that species. D.J.H. therefore agreed to carry out a molecular comparison of the two species, and J.K. was recruited to the team to provide a continental perspective. Volker Kummer and Hjalmar Thiel also provided specimens of related species for analysis. As a result of this study, we have concluded that the Soham material is indeed *P. ferruginosa*, although its teliospores are larger than those of the continental European specimens we have examined.

In addition to the question of the identity of the Soham fungus, the study provided an opportunity to take a preliminary look at the taxonomy of some British members of the *P. tanaceti* complex. Wilson & Henderson (1966) and Termorshuizen & Swertz (2011) treat *P. tanaceti* as a species recorded in Britain on three *Artemisia* species, *A. absinthium* (Wormwood), *A. maritima* (Sea Wormwood) and *A. vulgaris*, as well as two species of *Tanacetum*, a closely related genus in *Asteraceae* tribe *Anthemideae*, *T. coccineum* (Pyrethrum) and *T. vulgare* (Tansy). A previous generation of British mycologists separated *P. absinthii* on *Artemisia* from *P. tanaceti* on *Tanacetum* (Grove 1913), and much narrower species concepts are now followed in Central Europe (Table 1). Klenke & Scholler (2015) treat the common hemicyclic rust on *Artemisia vulgaris* as *P. artemisiella* P. Syd. & Syd., and for precision we have adopted this name in the text below.

Fig. 1. The site for *P. ferruginosa* at Soham, 12 August 2022. Photograph © C.D. Preston.

Puccinia ferruginosa at Soham

At Soham *P. ferruginosa* infected small plants of *Artemisia vulgaris* along the edge of a maize field on sandy soil, extending for about 14 m along a length of the field where the crop was rather less vigorous than elsewhere (Fig. 1). The infected plants extended 3–7 rows into the field, and perhaps further but it was impossible to investigate the interior of the stand without trespassing into the crop. Most of the hosts were vegetative plants only 4–25 cm high but a few were up to 55 cm high and in bud or flower; all consisted of a single stem, sometimes with very short axillary branches (Fig. 2). They had clearly regenerated (either from seed or vegetative fragments) after the field was last ploughed. Other weeds here included frequent *Chenopodium album*, much less frequent *Aethusa cynapium*, *Alopecurus myosuroides*, *Elymus repens* and *Silene latifolia* and the dried-up remains of *Poa annua* and *Senecio vulgaris*. There was no sign of *P. ferruginosa* on a few much larger flowering plants of *A. vulgaris* towards the edge of this colony, and nothing either on a large stand of full-grown plants along the edge of an adjacent field.

A more wide-ranging search of the area on 22 August 2022 failed to reveal any more *P. ferruginosa*, but there were two nearby populations of *P. artemisiella*. One on well-grown *A. vulgaris* plants at the corner of the same maize field, just 200 m away, had uredinia but no telia whereas the other, at the foot of a hedge alongside another maize field immediately east of the A142 road 0.76 km away, had a mixture of uredinia and telia.

In the cooler and moister summer of 2023 the *P. ferruginosa* field at Soham again supported a maize crop. *Artemisia vulgaris* was more frequent and vigorous at the edge than in 2022, with many flowering plants 60–90 cm high, accompanied by a much more varied assortment of other arable weed species. However, C.D.P. was unable to refind *P. ferruginosa* on *A. vulgaris* when he searched for it here on 23 August 2023.

Morphology of the Soham *P. ferruginosa*

A detailed search of the accessible edge of the maize field on 12 August 2022 revealed 22 infected *Artemisia* plants. These usually bore telia on the main stem leaves, extending from the yellowing lower leaves (wilting in the drought of the 2022 summer) to the green leaves just below the inflorescence of plants in bud or flower, with a few on the leaves of the short axillary branches. Plants had 1–5(–7) infected leaves and these leaves had 1–7(–11) telia, with two exceptional cases of leaves with 27 and c. 55 telia. There were no uredinia on any of these plants.

All the rust sori examined microscopically were confirmed as containing only teliospores. The telia were on the underside of the leaf, and associated with very conspicuous yellowish brown, brown or blackish brown leaf spots visible on both sides of the leaf, with depressions on the upper side of the leaf corresponding to the raised telia below (Fig. 3). Some telia on the main veins

	P. absinthii DC.	*P. abrotani* Fahrend.	*P. artemisiae-maritimae* Fahrend.	*P. artemisiella* P. Syd. & Syd.	*P. artemisiicola* P. Syd. & Syd.	*P. dracunculina* Fahrend.	*P. ferruginosa* P. Syd. & Syd.	*P. balsamitae* (F. Strauss) Rabenh.	*P. heeringiana* Kleb.	*P. tanaceti* DC.
Artemisia abrotanum L.		Rare								
absinthium L.	**Occasional**									
annua L.	Rare									
arborescens L.	Rare									
biennis Willd.	Rare									
campestris L.	Rare				Occasional					
dracunculus L.						Rare				
maritima L.			Rare							
verlotiorum Lamotte				Rare						
vulgaris L.	Error?			**Widespread**			**Occasional**			
Tanacetum balsamita L.								Rare		
coccineum (Willd.) Grierson								Rare		
parthenium (L.) Sch. Bip.									Rare	Rare
vulgare L.										**Widespread**

Table 1. Frequency of *Puccinia* species in central Europe with urediniospores and/or teliospores on the species of *Artemisia* and *Tanacetum*, following Klenke & Scholler (2015). Only hosts listed from Britain by Stace (2019), and the cultivated *T. coccineum*, are included. Combinations confirmed from Britain in this paper are shaded and in bold.

Fig. 2. Infected *Artemisia vulgaris* plants at Soham, 12 August 2022. Photograph © C.D. Preston.

Fig 3. Spots on upper side of an *Artemisia vulgaris* leaf above *P. ferruginosa* telia, Soham, 12 August 2022. Photograph © C.D. Preston.

(Fig. 4; compare German material shown in Fig. 5). The teliospores were two-celled, elongated or club shaped, mostly rounded and thickened to 8 µm at the apex, constricted in the middle, smooth, pale yellowish brown, measuring (38–)45–77 × 14–30 µm (mean 53.2 × 21.1 µm) with a hyaline stalk 45–95 × 4–7.5 µm (Fig. 6).

The telia are morphologically different to those of *P. artemisiella*, which has been the only rust to date found on *Artemisia vulgaris* in Britain. Telia of this species are more numerous once they are fully developed, smaller, usually less than 1 mm diameter (although they sometimes coalesce), pulverulent and less raised; there is no obvious depression on the opposite surface of the leaf although it is often discoloured (Figs 7, 8). Although more frequent on the lower side of the leaf, some telia often occur on the upper side too (perhaps especially towards the end of the season). The teliospores are dark, appearing almost black to the naked eye and a much deeper brown under the microscope than those of *P. ferruginosa* (Fig. 9).

Although the Soham rust resembles German *P. ferruginosa* in both the absence of uredinia and the appearance of its telia, there are reasons for hesitating to identify it as this species on the basis of morphology alone. Uredinia could conceivably have been present earlier in the season, although as

of the leaf distorted the leaf shape. The telia were round, ranging in size from 1 to 3.5 mm across, though sometimes elongated along leaf veins, punctiform, and firm rather than pulverulent; the smaller sori were covered by the matt of hairs of the host and difficult to see with the naked eye

noted above they were present in August 2022 in populations of *P. artemisiella* in similar habitats nearby. More significantly, perhaps, the teliospores of the Soham plant are 38–77 µm long, considerably longer than the length of 35–46(–54) µm given for *P. ferruginosa* in the origi-

Fig. 4. Telia of *P. ferruginosa* on lower side of an *Artemisia vulgaris* leaf, Soham, 12 August 2022. Photograph © C.D. Preston.

Fig. 5. Telia of *P. ferruginosa* on lower side of an *Artemisia vulgaris* leaf, Wesel, Germany, 20 September 2017. Photograph © J. Kruse.

Fig. 6. Teliospores of *P. ferruginosa* from Soham. Photograph © R.N. Stringer.

Box 1. Molecular methods.

We obtained as many samples as we could from rusts infecting hosts in the same tribe as *Artemisia* (*Asteraceae*: *Anthemidae*), to which we added some samples of related rusts with hosts in other tribes (*Astereae*, *Cichorieae*, *Cynareae*).

Portions of spore-bearing material were isolated by D.J.H. from the surface of infected leaves using a hypodermic needle and the DNA released using a quick extraction protocol (Mason & Botella 2020). The internal transcribed spacer (ITS2) and partial 28S ribosomal RNA gene regions were amplified with primers Rust2Inv (Aime 2006) and ITS4Ru1 (Rioux *et al.* 2015) using a Bento Lab thermal cycler (Bento Bioworks Ltd, London, UK). The PCR product was visualised and quantified using gel electrophoresis and amplicons forwarded to Aberystwyth University for Sanger sequencing at the IBERS Genomics Facility.

Sequences were checked manually and edited to correct base-call errors and ambiguous entries using SnapGene (www.snapgene.com). A dataset was compiled using sequences generated in this project and together with sequences supplied by JK. JK extracted DNA with DNeasy Plant Kit from Qiagen and amplified the LSU region by using LR6 and Rust2Inv (LR5 for sequencing). The PCR product was sequenced by Macrogen or at the sequencing lab at the Biodiversity and Climate Research Centre (BiK-F) at Frankfurt (Germany). Additional examples were downloaded from Genbank and a multiple sequence alignment was constructed using MAFTT (Katoh & Standley 2013) and phylogeny inferred using RaxML (Stamatakis 2014) as implemented in Geneious v. 10.

nal description of the species (Sydow & Sydow 1902), 33–54 µm by Gäumann (1959) and 38–56 µm on German material (from Bickenbach, Hesse) collected by J.K. (Fig. 10). Although the measurements of the teliospores of rusts on species of *Artemisia* given by different authors differ somewhat, the only species with such large teliospores is another microcyclic rust, *P. artemisiicola*, which has spores measuring 40–60(–70) × 19–27 µm according to Sydow & Sydow (1902). The teliospores of *P. artemisiicola* have an apical thickness up to 11 µm, but in the Soham rust and the German *P. ferruginosa* the apical thickness was 8–10 µm. However, this slight difference in the spores is insufficient to allow us to eliminate this species from consideration. *P. artemisiicola* is confined to the hosts *Artemisa campestris* and the central and eastern European species *A. austriaca* and *A. scoparia* in mainland Europe, and has not been recorded on *A. vulgaris*.

Because of our failure to identify the Soham rust unequivocally from morphological evidence, we decided that a molecular study might help to resolve its identity.

Molecular confirmation of the Soham *P. ferruginosa*

The molecular methods are outlined in Box 1. The Maximum Likelihood tree (Fig. 11) confirms the long-standing separation of *P. ferruginosa* from the hemicyclic species of the *P. tanaceti* complex, including *P. absinthii*, *P. artemisiae-maritimae*, *P. artemisiella* and *P. tanaceti* itself. It also confirms the identity of Soham *P. ferruginosa*, which is almost identical to the German samples analysed and differs from the one sample of *P. artemisiicola* we studied.

One surprising feature of the molecular analysis is that it places *P. heeringiana* (on *Argyranthemum* and *Tanacetum parthenium*) on the same branch as *P. ferruginosa* (on *Artemisia vulgaris*). We have identified the Soham rust as *P. ferruginosa* as it has the same host plant and the telia are similar in size and appearance, whereas they are much smaller (< 1 mm in diameter) in *P. heeringiana* (Klenke & Scholler 2015). In fact we strongly suspect that these two fungi, as currently understood in Europe, are conspecific; if they are then *P. ferruginosa* is the older name. We are extending our study to investigate this question further.

Puccinia ferruginosa in Europe and Asia

Most European records of *P. ferruginosa* are from *Artemisia vulgaris* in central Europe, especially Germany and Austria with further records from Norway, Switzerland, northernmost Italy (South Tyrol), Czechia, Romania and Russia. It has a scattered distribution in Germany, but is much less frequent on *A. vulgaris* there than *P. artemisiella*. In the recently published Red List of the plant parasitic microfungi of Germany, it is assessed as a rare but not endangered species (Thiel *et al*. 2023). J.K. has collected both species on the leaves of a single host plant, at Bickenbach, Hesse, sometimes growing on the same leaf, thus demonstrating that mixed infections of these rusts are possible. Jørstad (1932) described the microcyclic rust on *A. vulgaris* (which he recognised as corresponding to *P. ferruginosa*, but subsumed as a synonym of a very broadly defined species, *P. asteris* Duby) as fairly common in the more continental parts of southern Norway. He also cited records or collections from Onega in NW Russia and Novocherkassk in SW Russia. JK has confirmed the occurrence of *P. ferruginosa* in Norway, at Nyastølfossen. In view of the rather eastern distribution in mainland Europe, it is interesting that the Cambridgeshire record of *P. ferruginosa* is from sandy soils in the east of the county, approaching the East Anglian Breckland which is renowned for its relatively continental climate and flora. Further fieldwork will be needed before it becomes clear whether this is significant in indicating an eastern range of *P. ferruginosa* in Britain, or whether it is merely coincidental.

Puccinia ferruginosa is also known from China, Korea and Japan, and indeed the species was originally described from Japan (Sydow & Sydow 1902). However, a study by Engkhaninun *et al.* (2005) concluded that material ascribed to *P. ferruginosa* in Japan was polyphyletic, so the relationship of the European and eastern Asian material requires further study.

Taxonomic treatment of the *P. tanaceti* complex

The molecular analysis shows that the hemicyclic rusts on *Artemisia* traditionally included by British mycologists in the *P. tanaceti* complex are members of a clade, and thus are a related group of species, but it also provides support for the narrow species concepts advocated by Newcombe

Fig. 7. Uredinia and telia of *P. artemisiella* on lower side of an *Artemisia vulgaris* leaf, Heppenheim, Germany, 22 September 2019. Photograph © J. Kruse.

Fig. 8. Telia of *P. artemisiella* on lower side of an *Artemisia vulgaris* leaf from Kidwelly. Photograph © R.N. Stringer.

Fig. 9. Teliospores of *P. artemisiella* from Soham. Photograph © R.N. Stringer.

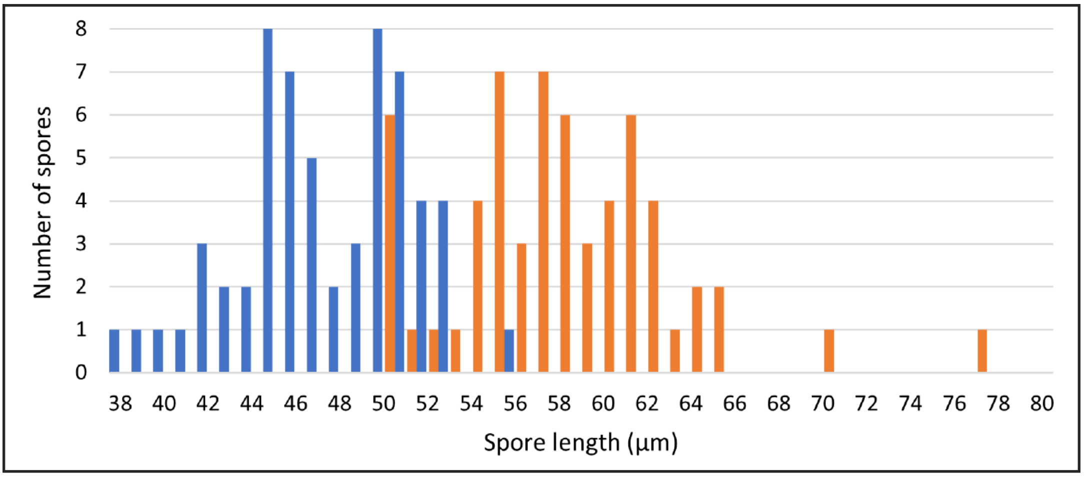

Fig. 10. Lengths of teliospores (n=60) of *P. ferruginosa* from Bickenbach, Germany (blue) and Soham, Britain (orange).

(2003) and currently applied by central European authors such as Klenke & Scholler (2015), as opposed to the broader concepts adopted by Anglo-Dutch authors, notably Wilson & Henderson (1966) and Termorshuizen & Swertz (2011). This is consistent with the earlier biological evidence which demonstrated that inocula from *P. tanaceti* s. str. could be used to infect *Tanacetum vulgare* but not *Artemisia absinthium* and species in related genera (Newcombe 2003). It confirms the presence of *Puccinia absinthii* on *Artemisia absinthium*, *P. artemisiella* on *A. vulgaris* and *P. tanaceti* sens. str. on *Tanacetum vulgare* in Britain. *Puccinia artemisiae-maritimae* also occurs in Britain, on *Artemisia maritima*, but we did not have a British specimen available for inclusion in this study.

Puccinia artemisiicola

One obvious absence from Britain is the microcyclic rust *P. artemisiicola* on *A. campestris* (Table 1). The host is a very rare species in England, confined as a native to Breckland but also known as an established introduction in coastal sites (Stroh *et al.* 2023). C.D.P. has searched the largest surviving Breckland population of the species, and cultivated stock in Cambridge University Botanic Garden, without finding any rust infection, but further searching might be rewarded.

Details of samples studied

The following *Puccinia* samples on *Artemisia* have been included in the morphological or molecular analysis reported above. Their GenBank numbers (prefixed by OQ or OR) are included.

Puccinia absinthii (on *Artemisia absinthium*). Britain, Cambridgeshire (v.c. 29): Flower border W. of King's College chapel, Cambridge, TL445583, C.D.P., 22 August 2022 (II, III), Preston 4664, OQ981982. Carmarthenshire (v.c. 44): On *A. absinthium* 'Lambrook Silver', Gelli Deg, Llandyfaelog, Kidwelly, SN422105, I.K. Morgan, 25 August 2022 (II, III), OQ981983.

Puccinia artemisiae-maritimae (on *Artemisia maritima*). Germany, Schleswig-Holstein: Salzwiese c. 0.5 km N.O. Nebel, Amram, Nordfriesland, MTB 1316/13, H. Thiel, 19 October 2022 (III), Thiel 22/010, OR558268.

Puccinia artemisiella (on *Artemisia vulgaris*). Britain, Cambridgeshire (v.c. 29): N. side of track to Wet Horse Fen immediately E of A142, Soham, TL607724, C.D.P., 22 August 2022 (II, III), Preston 4663, OQ981984. Carmarthenshire (v.c. 44): Roadside hedge, Coleman Farm, Kidwelly, SN396069, R.N.S., 7 September 2017 (II, III). Germany, Hessen: Kr. Darmstadt-Dieburg, W. of Bickenbach, Ruderalflur, MTB 6217/23, J.K., 8 October 2022 (II, III), OQ981985.

Puccinia ferruginosa (on *Artemisia vulgaris*). Britain, Cambridgeshire (v.c. 29): By track between Little Bank Drove and Soham Lode,

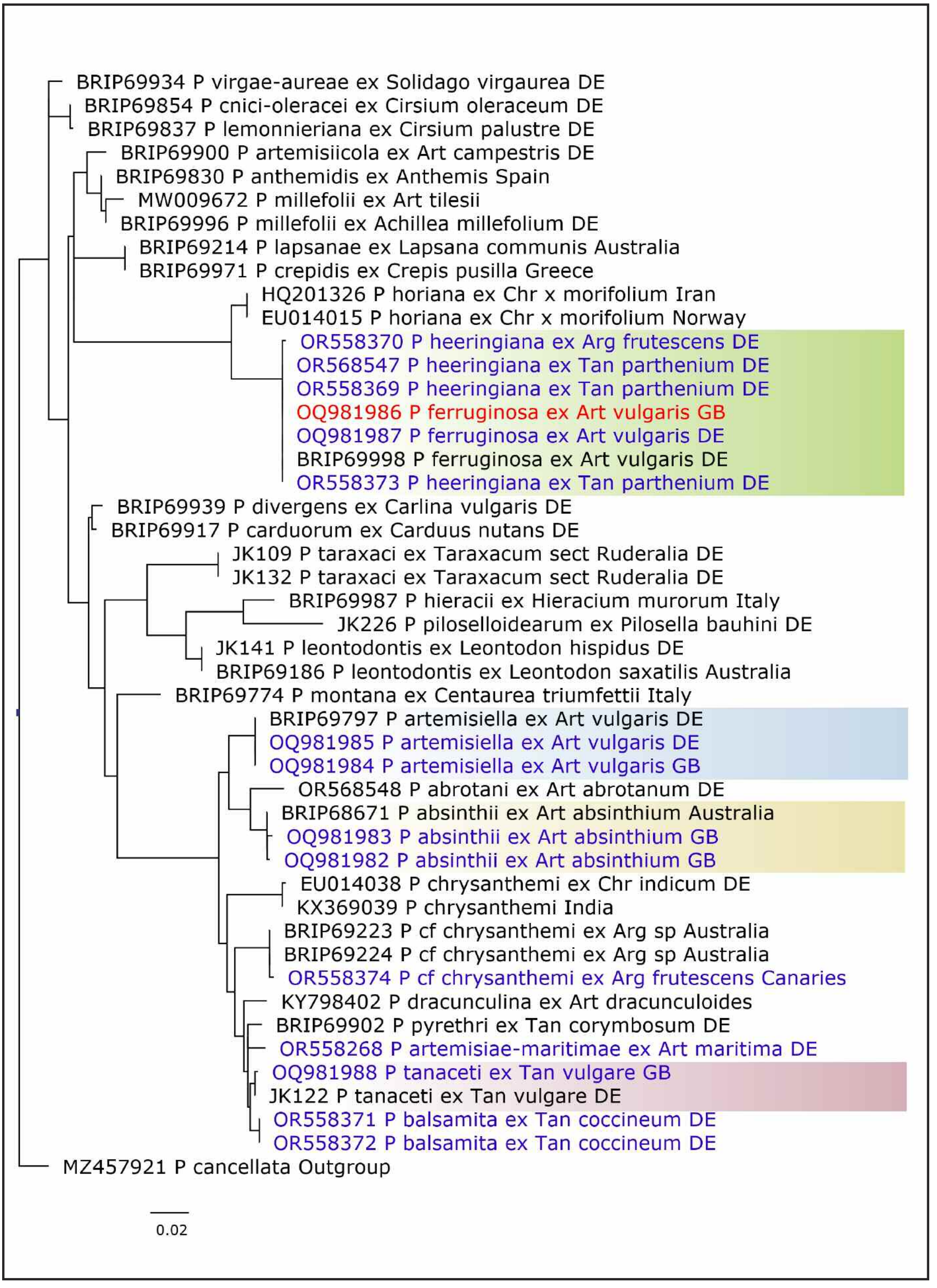

Fig. 11. Maximum Likelihood tree inferred from sequences of the ITS and 5.8S regions using RAxML. The sequence from the Soham *P. ferruginosa* is shown in red and the other sequences generated by the authors to support this study in blue. The abbreviated plant genera are **Arg**yranthemum, **Art**emisia, **Chr**ysanthemum and **Tan**acetum. Samples from Britain and Germany are indicated by GB and DE respectively. Codes BRIP and JK refer to specimens held in the Queensland Plant Pathology Herbarium, Brisbane and by J.K. respectively. Rust clades discussed in this article are highlighted.

Soham, TL611731, C.D.P., 8 August 2022 (III), Preston 5185; 12 August 2022 (III), Preston 5192; 22 August 2022 (III), OQ981986. Germany, Hessen: Kr. Darmstadt-Dieburg, W. of Bickenbach, Ruderalflur, MTB 6217/23, J.K., 8 October 2022 (III), OQ981987.

Acknowledgements

We are grateful to Volker Kummer and Hjalmar Thiel for giving us specimens for inclusion in the molecular analysis. Thanks are also due to Alan Leslie and Jo Sharman for identifying the *Artemisia* cultivated at King's College, to the British Mycological Society and Brian Douglas for their support through the BMS DNA barcoding programme, to Caron Evans (IBERS) for DNA sequencing support and advice, to S. Ploch (BiK-F) for help with the amplification of some rust fungi and to R. Shivas for financial support with DNA extraction and sequencing in Australia.

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Coccomyces delta new to Britain with a brief synopsis of other British species

Brian Spooner* & Fay Newbery**

The genus *Coccomyces* (*Rhytismatales*, *Rhytismataceae*) has a virtually cosmopolitan distribution, including species in both temperate and tropical regions. Ascomata are stromatic, circular to angular in outline, with usually carbonised basal and covering layers, the latter opening by teeth, mostly along radial pre-formed lines of dehiscence, or sometimes irregularly. They are mostly saprotrophic and occur on fallen leaves, twigs or bark, or on *Rubus* canes. On leaves the ascomata occur in bleached or pale areas, often bounded by a black stromatic line. Ascospores are hyaline, cylindric or filiform, often with a thin gel sheath, and non-septate. A pycnidial stage referable to form-genus *Leptothyrium*, with hyaline, bacilliform to cylindric conidia, is known for some species. The genus was monographed by Sherwood (1980), though a number of species have been described since then, with around 140 currently recognised.

Various other genera of this family also have orbicular ascomata which open by teeth, but differ from *Coccomyces* particularly in structure of the ascocarps and ascospore morphology. A key to distinguish them is given by Sherwood (1980). Two other genera in this family, *Hypoderma* and *Lophodermium*, are also similar but differ most evidently in having elliptic to elongated ascomata which open by a single longitudinal slit.

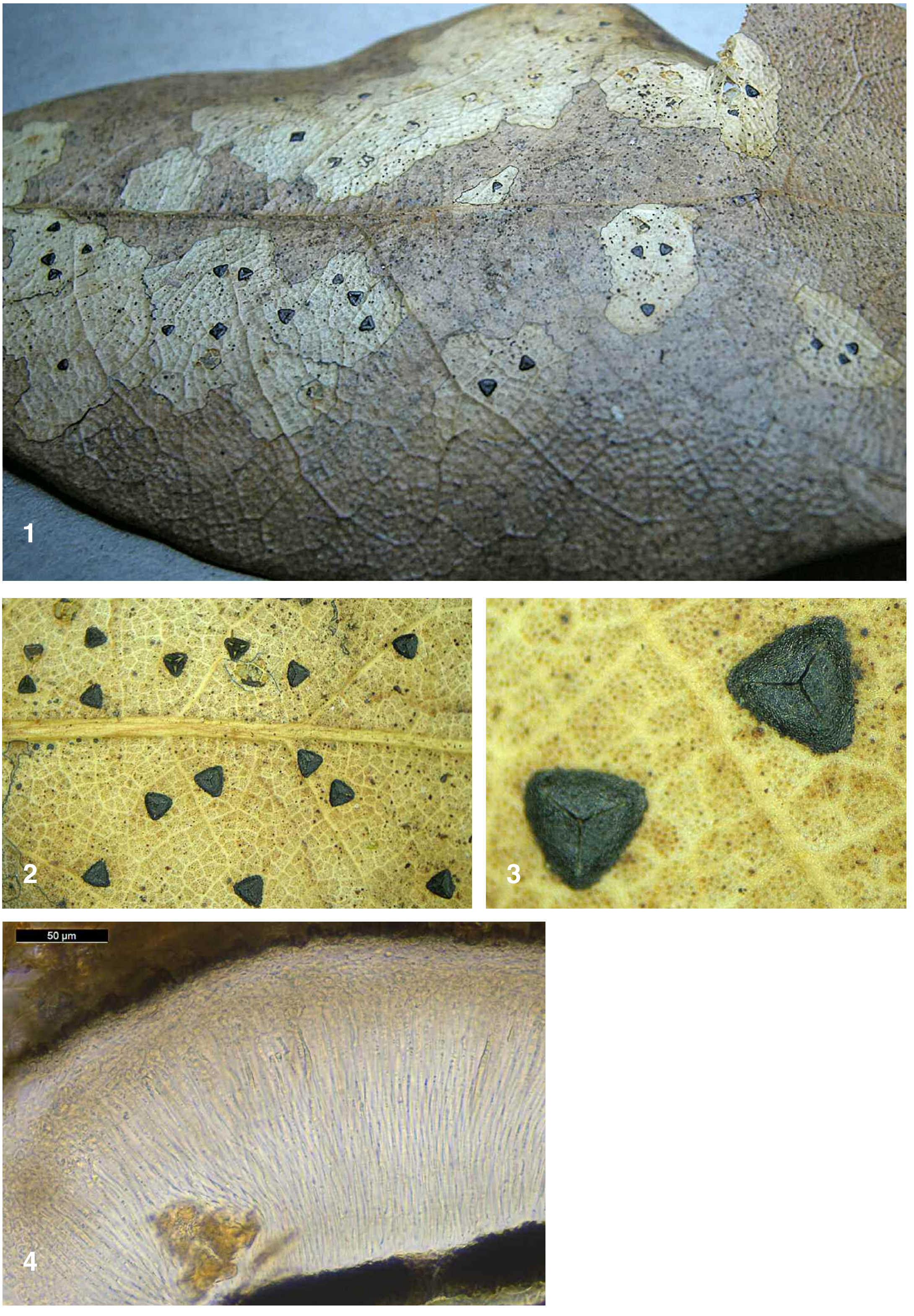
Recently, two collections of a *Coccomyces* on fallen leaves of *Laurus nobilis* have been made from southern England, from Devon and the Isle of Wight. They prove referable to *C. delta* which has not previously been reported from Britain. This species is otherwise known from the Mediterranean region and Atlantic Islands on fallen, coriaceous leaves of *Lauraceae* as well as some of the evergreen oaks (especially *Q. coccifera*). It has also been reported from Australia on leaves of *Eucalyptus* spp, but evidently in error for *C. globosus* Johnston (Johnston 2000).

Fallen leaves of *Laurus nobilis* have proved to be an exceptionally rich substrate for microfungi, as shown by the detailed studies by Kirk (1981, 1982, 1983) and Kirk & Spooner (1989), in which over 120 species have been documented from Britain, several of them having been previously undescribed. However, *C. delta* was not amongst the species treated in these accounts and was evidently not present in Britain at that time.

Coccomyces delta (Kunze) Sacc., Handb. Austral. fungi: 272 (1892).
= *Phacidium delta* Kunze, Linnaea 5: 551 (1830).
= *Phacidium quercinum* Desm., Pl. Crypt. France 1644 (1847)
= *Coccomyces quercinus* (Desm.) Terrier, Essai Syst. Phacid.: 39 (1942)

Ascomata on fallen leaves, amphigenous, mostly epiphyllous, (0.4-) 0.5–0.8 mm across, intraepidermal, on bleached areas sometimes partly bounded by a fine, dark zone-line, black, mostly triangular or sometimes quadrangular in outline, with well-defined preformed lines of dehiscence, opening by 3(-4) teeth. Covering layer c. 30 µm thick, comprising small, angular cells 5–10 µm across, heavily carbonised towards the lips, bordered by small, periphysis-like cells. Lower stroma also carbonised, thin, one cell thick, overlain by larger pseudoparenchymatous cells. Asci 8-spored, cylindric-clavate, tapered at apex, short-stalked, thin-walled, I-. Paraphyses filiform, simple, with apex slightly clavate, c. 3 µm wide. Ascospores filiform, 80–100 x c. 2 µm, with gel sheath, hyaline, non-septate, lying parallel in the ascus. Pycnidial stage absent. Figs 1–4.

Collections examined (both on fallen leaves of *Laurus nobilis*):
Devon, Ottery St Mary, SY100957, 19 Jul. 2022, M. Salter & B. McGhie; Hants, Isle of Wight, Shanklin, 17 Dec. 2022, I. Outlaw & C. Pope, K-M1436651.



Figs 1 – 4. *Coccomyces delta*, on fallen leaves of *Laurus nobilis*.
Figs 1 – 3. Ascomata. Isle of Wight, Shanklin, Dec 2022. Photos: I. Outlaw.
Fig. 4. Vertical section of ascoma to show hymenium. Devon, Ottery St. Mary, Jul 2022. Photo: F. Newbery.

Other British species of *Coccomyces*: brief descriptions and occurrence

C. arctostaphyli (Rehm) B. Erikss. 1970
C. quadratus (Schmidt & Kunze) Karst. var. *arctostaphyli* Rehm 1912
Amphigenous, subepidermal on dead or fading leaves, in leaf spots lacking a black border, triangular to quadrate, opening by 3–5 teeth. Covering stroma black, carbonised. Asci mostly 4-spored; ascospores 45–55 x 2–2.5 µm, non-septate, with gel sheath. Pycnidia apparently lacking.

On leaves of *Arctostaphylos uva-ursi*. Seemingly very rare, or perhaps overlooked; until recently reported only from *A. uva-ursi* from Wester Ross, Kyle of Lochalsh, 20 Oct. 1972. Recently reported from the Cairngorms, and on *A. alpinus* from Ben Wyvis.

Elsewhere known from Western & Northern Europe and Western North America.

C. boydii A.L. Smith 1907
Apothecia on bark of dead branches, immersed, opening irregularly, mostly 1–1.5 mm across, hymenium pale yellowish. Asci 8-spored; ascospores 50–55 x c. 1 µm.

On *Myrica gale*. Perthshire, Killin, July 1907. Known only from the holotype.

C. coronatus (Schum.) de Not. 1859
Apothecia intraepidermal, on decaying leaves, in bleached spots usually partly bounded by a thin stromatic line, with microsclerotia sometimes present; rounded or polygonal in outline, black, lacking a preformed dehiscence mechanism, to c. 2 mm across, opening by 4–6 or more teeth, hymenium pale orange. Paraphyses apically inflated to 4–5 µm wide; asci 8-spored, 100 – 130 µm long; ascospores 60–80 x 2–2.5 µm, non-septate. Pycnidial state apparently lacking (Sherwood 1980), though a *Leptothyrium* state has been referred here by some authors, including Grove (1937).

Most commonly on *Quercus*, occasionally on *Castanea* and *Fagus*, and more rarely on *Betula* and *Rhododendron*.

C. dentatus (Schmidt & Kunze) Sacc. 1877
C. mahoniae Grove in Herb.
C. rhododendri Rehm ss auct. Brit.
Leptothyrium quercinum Sacc. (anam.)
Apothecia on leaves, in bleached areas mostly bounded by black lines, intraepidermal, usually with pycnidia present, black, quadrate to hexagonal, 0.5–1 mm diam., opening by 4–5 teeth along preformed lines of dehiscence, hymenium pale yellowish. Asci 8-spored; ascospores 45–65 x c. 2 µm, with narrow gel sheath. Pycnidia developed first, 0.1–0.3 mm across, with hyaline, bacilliform conidia 4–5 x 1 µm.

On dead leaves of *Quercus*, including *Q. ilex*, *Q. coccinea* and *Q. rubra*, and *Castanea*, occasionally on *Mahonia* and *Rhododendron*. Common.

C. leptideus (Fr.) B. Erikss. 1970
C. quadratus (Schmidt & Kunze) Karst. 1871
Apothecia 0.5–1 mm diam., on bleached spots on living or recently killed twigs, quadrangular to hexagonal, opening along preformed lines of dehiscence; covering layer black, heavily carbonised. Asci 4- or 8-spored, long-stalked. Ascospores 60–90 x 3–3.5 µm (in 8-spored asci) or x 4–5 µm in 4-spored asci. Pycnidia lacking.

On *Vaccinium myrtillus* and with a single record on *V. vitis-idaea*. Known mostly from Scotland, also from Cumberland and recently from Yorkshire and Wales. Also recorded in North America from *Gaultheria shallon* and *Rhododendron* spp.

C. tumidus (Fr.) de Not. 1847
Coccomyces trigonus (Schmidt & Kunze) Quelet 1886
Coccomyces striatus (Phill. & Plowr.) Massee 1895
Apothecia subcuticular, on dead leaves of various hosts, on bleached areas bounded by a black line, 1–2 mm across, rounded or rarely elongated in outline, blackish-brown, hat-shaped, with flat brim, depressed at centre, splitting open irregularly by teeth or longitudinal slit, hymenium dull yellowish. Covering layer thick, not heavily carbonised. Asci 8-spored, long-stalked. Ascospores 32–45 x 3–4.5 µm, non-septate. Pycnidia lacking.

British collections on *Quercus*, *Castanea*, *Sorbus aucuparia*, *Rubus* stem. Common in Europe and North America.

Excluded species

Coccomyces clematidis (Phill.) Sacc. 1889
Phacidium clematidis Phill., 1888 (Holotype: Carlisle, Dr. Carlyle, on stems of *Clematis vitalba*).

= ***Karstenia clematidis*** (Phill.) Sherwood 1980

Coccomyces juniperi (Karst.) Karst. 1871
Clithris juniperi (Karst.) Rehm 1888
= ***Colpoma juniperi*** (Karst.) Dennis 1957

Coccomyces pini (Alb. & Schwein.) Karst. 1871
= ***Therrya pini*** (Alb. & Schwein.) Höhnel 1926

Coccomyces rhododendri (Schw.) Sacc. 1889
= ***Lophodermium schweinitzii*** M. Wilson & N.F. Robertson 1947

Coccomyces rubi (Fr.) Karst. 1871.
= ***Coleroa chaetomium*** (Kunze) Rabenh. 1851

Key to British species

1. On woody substrates, bark or twigs 2
1. On dead leaves 3

2. On *Myrica*; on bark of dead branches; opening irregularly; ascospores < 60 µm long, c. 1 µm wide . . . . ***C. boydii***
2. On *Vaccinium*; on living or recently killed twigs; opening along preformed lines of dehiscence; ascospores longer than 60 µm, 3 µm or more in width . . . . ***C. leptideus***

3. On *Arctostaphylos*; asci mostly 4-spored. [ascospores 45 – 55 x 2 – 2.5 µm, non-septate, with gel sheath] . . . . ***C. arctostaphyli***
3. On other hosts; asci 8-spored. 4

4. On leaves of *Laurus nobilis*; ascomata triangular or occasionally quadrangular in outline; ascospores 80 – 100 x 2 µm . ***C. delta***
4. On other hosts; ascomata mostly not triangular in outline; ascospores shorter . . . 5

5. Ascospores 3–4.5 µm wide, 32–45 µm long. Ascomata subcuticular, on various hosts . . . . ***C. tumidus***
5. Ascospores 2 – 2.5 µm wide, longer than 45 µm. Apothecia subepidermal, mostly on *Fagaceae* 6

6. Ascomata to 1 mm across, opening along pre-formed lines of dehiscence. Pycnidia present; paraphyses simple, 2–2.5 µm at apex; ascospores 45 – 65 µm long. On *Quercus* & *Castanea*, rarely other hosts. . . . ***C. dentatus***
6. Ascomata to 2 mm across, lacking preformed lines of dehiscence. Pycnidia apparently lacking but microsclerotia may be present; paraphyses apically inflated to 4 – 5 µm, ascospores 60–80 µm long. On various hosts . . . . ***C. coronatus***

Acknowledgements

Thanks are due to Colin Pope, Isle of Wight, for forwarding the Shanklin collection, and to Ian Outlaw, Isle of Wight, for the accompanying images of the ascomata; M. Salter & B. McGhie, Devon, are thanked for the Devon collection.

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Notes and Records

Alick Henrici*

In my column in the last issue I noted that most genera of mycorrhizal agarics appear to make their appearance in a simultaneous flush as soon as weather conditions turn favourable. I speculated on when this might happen in 2023. As usual summer and autumn in Kew this year turned out far from `usual'. The widely reported abnormally wet July didn't happen in Kew. In early September the temperature reached 32.7°, the highest anywhere in Britain all year.

An hour's wandering in Kew Gardens on 4 Oct. revealed a ring of *Chlorophyllum rhacodes* fruiting happily amid the drought, but apart from these only meagre specimens of just four other agarics, no *Marasmius oreades* in the grass, no *Bolbitius titubans*, not even a *Panaeolina foenisecii*! As late as 18 Oct. the only plentiful mycorrhizal was *Inocybe geophylla*. The eagerly awaited autumn flush only got started while I was away for a week in Scarborough from Oct 22. on the BMS autumn foray.

Even on my return, searching under the two *Castanea* trees that had yielded 15 simultaneously fruiting mycorrhizal species in 2015, only at most four of these were now visible: *Russula atropurpurea* which is always abundant there, *R. farinipes* and two *Cortinarius* species which might or might not have been the same as in. 2015, but alas remained unidentified on both occasions. There were however two *Inocybe* species not present in 2015. These, at least, were evidence of what all dedicated forayers get to know: however long you research your favourite site, new species will continue to turn up and old species will appear in new places.

More about *Lentinus*

Also in the last issue I discussed the awkward DNA revelation that the macroscopic distinction between *Polyporus* (poroid) and *Lentinus* (gilled) is of little significance in evolutionary terms. Both genera are heterogeneous. Some traditional polypore species (*P. brumalis* and its summer relative *P. ciliatus*) have had to move to *Lentinus*. I listed the further changes to *Polyporus*. The report in this issue (p.142) of a new British *Lentinus* (now also moved) has triggered the following further notes.

There are complications. How is *Lentinus* defined, in particular what is its type species? Fries erected *Lentinus*, distinct from almost all other gilled fungi lumped together in *Agaricus*, on account of its toughness (latin *lentus* = pliant or tough). His type species was Linnaeus's *Agaricus crinitus*, of which he gave a short description based on Swedish material. Singer (1986) devoted an entire page of small print to pointing out that Fries had boobed. *L. crinitus* is an American species. He, Singer, had examined its type material. It was nothing like Fries's description which was plainly of the European *L. lepideus*, which Singer considered should thus be treated as the generic type.

Next complication: Singer was writing in the pre-DNA era. He placed Redhead's genus *Neolentinus* in synonymy with *Lentinus*. DNA now shows that the two are very different, not even belonging in the same order. Singer's proposed type species is now the type of *Neolentinus*, placed in the small and very distant brown-rotting order *Gloeophyllales*. The world has reverted to *L. crinitus* as type species, despite Fries's highly erroneus type description.

Neofavolus suavissimus, newly reported as British in this issue, brings two further generic names into the *Lentinus* melée, as it was also at one time in *Panus*. In *Funga Nordica* it is still in *Lentinus*, one of just two European species surviving there (the other being *L. tigrinus*) . In 2013 it was made the type of its own new genus and found to be close to the southern European *Polyporus alveolaris* which was thus also transferred to *Neofavolus*. Both are treated in this genus in *Fungi of Temperate Europe* (Lmssoe & Petersen, 2019). As for *Panus*, the one British species used to be known as *P. torulosus*, for some it became *Lentinus torulosus*, but in all recent literature it is now *P. conchatus*. It is as tough as a *Lentinus*, but more pleurotoid in aspect.

This account excludes the half dozen or so species also placed in *Lentinus* in the more distant past but now in *Lentinellus*, More convergent evolution. These belong in neither the *Polyporales* nor the *Gloeophyllales*, but in the *Russulales*.

Summary of the British species:
L. adhaerens ➞ *Neolentinus a.*
Neolentinus lepideus ➞ *Neolentinus l.*
L. schaefferi ➞ *Neolentinus s.*
L. suavissimus ➞ *Neofavolus s.*
L. tigrinus ➞ *stays in Lentinus*!
L. torulosus ➞ *Panus conchatus*

New and spectacular
Update 10 to the basidio checklist (https://fungi.myspecies.info/content/checklists) triumphantly announced a net gain of 91 British species in 2022. That's getting on for two a week. Get your collection DNA'd and there's a good chance it's new! But here in this issue of FM we have two cast-iron spectacular novelties found in England. One wonders how *Neofavolus suavissimus* had managed to evade around 150 years of diligent field mycologists. Either its habitat is extremely limited or it's at the start of an unexplained expansion in range as exhibited by several species in recent years. It is fairly widespread but also rare further east in northern Europe. As for *Entoloma jennyae* (p. 113 in this issue), what could be rarer than a large pretty distinctive species previously known in the world only from one Irish bog thirty years ago.

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(Updates 1-11 are available online at: https://fungi.myspecies.info/content/checklists)
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The first British record of *Neofavolus suavissimus*

Peter Cowling*

During the BMS Ascomycete Workshop in Ambleside, Cumbria, on 27 August 2023, the author was exploring an old wetland *Salix* carr in the National Trust Nature Reserve of Blelham Bog at the corner of Blelham Tarn (Grid Ref NY36277 00260, Vice County Westmoreland) with two colleagues when he noticed a strong odour of aniseed in the air (but described by the two colleagues as 'marzipan' and a third colleague later as 'fennel'). Searching the immediate vicinity, he spotted two shoulder height, cream coloured fruiting bodies on a living *Salix* branch (Fig. 1). A sniff of these confirmed them to be the source of the smell. One fruiting body was collected and, over the course of the day, the aniseed was found to permeate the laboratory environment, the hands of those who came into contact with the fungus and the wood substrate. Not only was it powerful, but it was also lingering in the manner that a commercial perfume lingers.

The morphology and size of the fruiting bodies can be seen in Fig. 1. Of note was the eccentric stipe and the tough flesh which made squash preparations rather difficult. Fig. 2 shows the numerous intermediate gills with a serrated edge and a somewhat decurrent attachment to the stipe (Fig. 2). The spore print was white, and spores examined in water from the desiccated specimen were smooth, ellipsoid and an average of 7.2 x 3.6 µm. In Melzer's solution they were inamyloid.

Examination of the gills in situ with a dissecting microscope showed peg-like extrusions extending from the gill sides at right angles which is a characteristic of this species.

A previous claim of this species as British was made on behalf of a collection on an oak stump in

Oxfordshire in 1990 under its then current name of *Panus suavissimus*. This was later redetermined at Kew as *Panus conchatus*. The epithet *suavissimus* thus featured in the printed Checklist (Legon & Henrici, 2005) only in the section listing Excluded Species.

The author has also received a verbal report from Helen Speed of a specimen of *N. suavissimus* which was found on an All Scottish Group Foray in 2021. The description given was an excellent one for this species but it was not recorded.

This species is easy to identify. It really could not be anything else given the powerful aniseed aroma, the toughness of the fruiting body, and the specific habitat of old, wet, *Salix* carr.

It is interesting to speculate on the possible selective evolutionary advantage to a fungus in producing such a powerful, lingering, odour detectable at a distance. Perhaps the fungus is using molecular mimicry to emulate a fragrant plant and thereby divert insect vectors as a second mechanism of spore dispersal? However, that hypothesis requires further research.

Acknowledgments

Thanks to Thomas Læssøe, Caroline Hobart, Sue Marr, Emma Williams, and David Bentley for assistance in identification. Thanks also to Helen Speed for her personal communication of her find of this species in Scotland in 2021.

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Fig. 1 left. *Neofavolus suavissimus* in situ on a branch of Salix. Photo © Peter Cowling.

Fig. 2 below. The serrated gills of *N. suavissimus*. Photo © Peter Cowling

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