

***Sorbus whiteana* (Rosaceae), a new endemic tree from Britain**

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ABSTRACT

Sorbus whiteana T. C. G. Rich & L. Houston, a new endemic tree from the Avon Gorge and Wye Valley, is described. It is distinguished from other members of the *S. aria* (L.) Crantz group in Britain by the obovate, unlobed leaves which are greenish underneath, and the fruits being longer than wide. It is triploid. About 76 plants are known in four populations and a plant from another locality require confirmation. The complex history of its discovery is set out; it has been confused with *S. wilmottiana* E. F. Warb. and *S. hungarica* (Bornm.) Hedl. ex C. E. Salmon.

KEYWORDS: Avon Gorge, Bristol, *Sorbus aria* group, Whitebeam.

INTRODUCTION

The Avon Gorge in Bristol is home to at least nine native and four introduced taxa of *Sorbus*, Whitebeams, and is the richest and most important *Sorbus* site in Britain. Of the rarer species, *S. bristoliensis* Wilm. and *S. wilmottiana* E. F. Warb. are endemic to the Avon Gorge, *S. eminens* E. F. Warb and *S. porrigentiformis* E. F. Warb. are endemic to England and Wales, and *S. anglica* Hedl. is endemic to Britain and Ireland. The commoner native species in the Avon Gorge are *S. aria* (L.) Crantz *sensu stricto*, *S. aucuparia* L. and *S. torminalis* (L.) Crantz, and the introduced species are *S. croceocarpa* P. D. Sell, *S. decipiens* (Bechst.) Irmisch, *S. intermedia* (Ehrh.) Pers. and *S. latifolia* (Lam.) Pers.

In this paper we describe a ninth native *Sorbus* from the Avon Gorge (the fifth species there that is endemic to Britain). It is a member

of the *S. aria* group, of which four other members also occur in the Avon Gorge (*S. aria sensu stricto*, *S. eminens*, *S. porrigentiformis* and *S. wilmottiana*). It has been known from the Avon Gorge for some time but not differentiated; it has also recently been found in the Wye Valley.

METHODS

Broad leaves from the short vegetative shoots, excluding the oldest and youngest leaf (Aas *et al.* 1994) were measured on herbarium material in NMW. Fruits were measured on fresh material, and the colours matched against the Royal Horticultural Society colour charts (Royal Horticultural Society 1966).

Potential pollen viability was investigated using Alexander's Stain (Alexander 1969) on the three flowering collections available. Anthers were removed from herbarium specimens with tweezers under a low-power binocular microscope, and placed on a slide with a drop of Alexander's Stain, warmed briefly on the hotplate, then broken up with the tweezers. The preparation was then covered with a coverslip and replaced on the hotplate to improve the uptake of the stain. The slides were then examined under a high-power compound microscope for areas of dense pollen grains. Potentially viable grains were counted as those which were large and rounded-triangular with cell walls which stained green and with cytoplasm inside which stained uniformly bright red. Small deformed grains or those staining green only with very little or no red staining inside (i.e. no cytoplasm) were considered infertile.

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Chromosome numbers were determined using standard methods. Tips of actively growing roots were collected mid-morning and pre-treated in 8-hydroxyquinoline solution for 20–24 hours at 4°C. They were then fixed in a 3:1 mixture of absolute ethanol: glacial acetic acid and stored at 4°C until needed. Root tips were then hydrolysed in concentrated 5N HCl for 10 minutes at room temperature, then stored in 70% industrial methylated spirits. Meristems were dissected out in 45% acetic acid, and squashed between a microscope slide and coverslip in 0.1% aceto-orcein stain with brief flame treatment.

The distribution was assessed from herbaria (**BIRM**, **BM**, **BRISTM**, **CGE**, **K**, **NMW**, **OXF** and **UPS**; abbreviations following Kent & Allen 1984), and from extensive *Sorbus* field work in South-west England and South Wales between 1996 and 2005.

RESULTS

A small amount of morphological variation was found within and between populations. Some plants from the Avon Gorge have relatively large leaves, and the plant from Lady Park Wood had relatively more veins. Typical leaves from the short shoots are illustrated in Figure 1.

Potential pollen fertilities were found of 43% for one plant on the top northern edge of Great Quarry, Clifton Down (voucher NMW.V.2002.17.189), 68% for another plant in woodland nearby (NMW.V.2004.3.109), and 62% for a plant from the Great Quarry (NMW.V.2003.1.154, = Lemche's *aria*33), giving an overall mean of 58%. A few giant pollen grains (cf. Liljefors 1955) were noted in the latter collection.

Chromosome counts of $2n = 51$ (triploid) have been obtained for a single plant grown from seed collected from the holotype tree in Quarry 3 in the Avon Gorge, and from Ban-y-gor cliffs (voucher NMW.V.2002.17.103) (J. Bailey, pers. comm. 2004). The potential pollen fertility is perhaps higher than might be expected for a triploid.

Sorbus whiteana T. C. G. Rich & L. Houston, sp. nov.

HOLOTYPE: Near top centre of Quarry 3, Leigh Woods, Avon Gorge, Bristol, v.c. 6 North Somerset, 21 August 2002, T. C. G. Rich & L. Houston (**NMW**, accession number V.2002.17.50). **ISOTYPE:** **BM**.

Vernacular name: White's Whitebeam.

Frutex vel arbor parva ad 10 m ut minimum. Petioli 9–20 mm. Folia lata brachyblastorum (8.5–)9.3–13.6(–14.8) × (5.0)–5.6–8.7(–9.6) cm, (1.3–)1.4–1.9(–2.0) plo longiora quam latiora, obovata vel obtrullata, ad longitudinis suae (53–)55–65(–69) partes centesimas latissima, apice acuto vel obtuso, basi cuneata, plerumque non lobata vel interdum (praecipue in umbra) leniter lobata, marginibus uniserratis vel leniter biserratis, dentes prope apicem extra sed in parte inferiore magis prorsum projectos ferentibus, sed c. 1 cm infimo prope petiolum fere integro; pagina superior glabrescens viridis, pagina inferior cinereoviridis tomentosa, venarum paribus (7.5–)8.5–11.5(–12.5) ad angulum (24–)26–35(–37)° a costa tentis. Inflorescentia aggregata, tholiformis, ramulis viridialbis tomentosis instructa. Flores ad 17 mm lati. Sepala anguste triangularia, patentia, tomentosa sed ad apicem viridia, eglandulata. Petala (6–)7–10 × 5–7 mm, circularia vel late elliptica ungue brevi, alba, cupulata, pilis effusis ad basin vestita. Stamina c. 20, antheris luteis e roseo suffusis. Styli 2, virides, usque ad basin discreti, basi pilosi. Fructus maximi (9.5–)10–13.5(–14) × (9–)10–13(–14) mm, (0.85–)0.9–1.1(–1.2) plo longiores quam latiores, plerumque aspectu longiore quam latiore, interdum globosi, in medio latissimi, lenticellis sparsis vel satis frequentibus parvis vel mediocribus super superficiem dispersis, interdum ad basin aliquot pluribus, in maturitate rubri.

Shrub or small tree to at least 10 m. Petioles 9–20 mm. Broad leaves of short shoots (8.5–)9.3–13.6(–14.8) × (5.0)–5.6–8.7(–9.6) cm, (1.3–)1.4–1.9(–2.0) times as long as wide, obovate to obtrullate, widest at (53–)55–65(–69)% along leaf length, with apex acute to obtuse and base cuneate, usually unlobed or sometimes (especially in shade) weakly lobed, with margins uniserrate to weakly biserrate, with teeth at the top directed outwards, those below directed more forwards, but with lowest c. 1 cm near petiole nearly entire; upper surface glabrescent, green, lower surface greyish-green tomentose, with (7.5–)8.5–11.5(–12.5) pairs of veins held at an angle of (24–)26–35(–37)° to midrib. Inflorescence crowded, domed, with branchlets greenish-white tomentose. Flowers up to 17 mm across. Sepals narrowly triangular, spreading, tomentose but green at tip, eglandular. Petals (6–)7–10 × 5–7 mm, circular to broadly elliptic with a short claw, white,

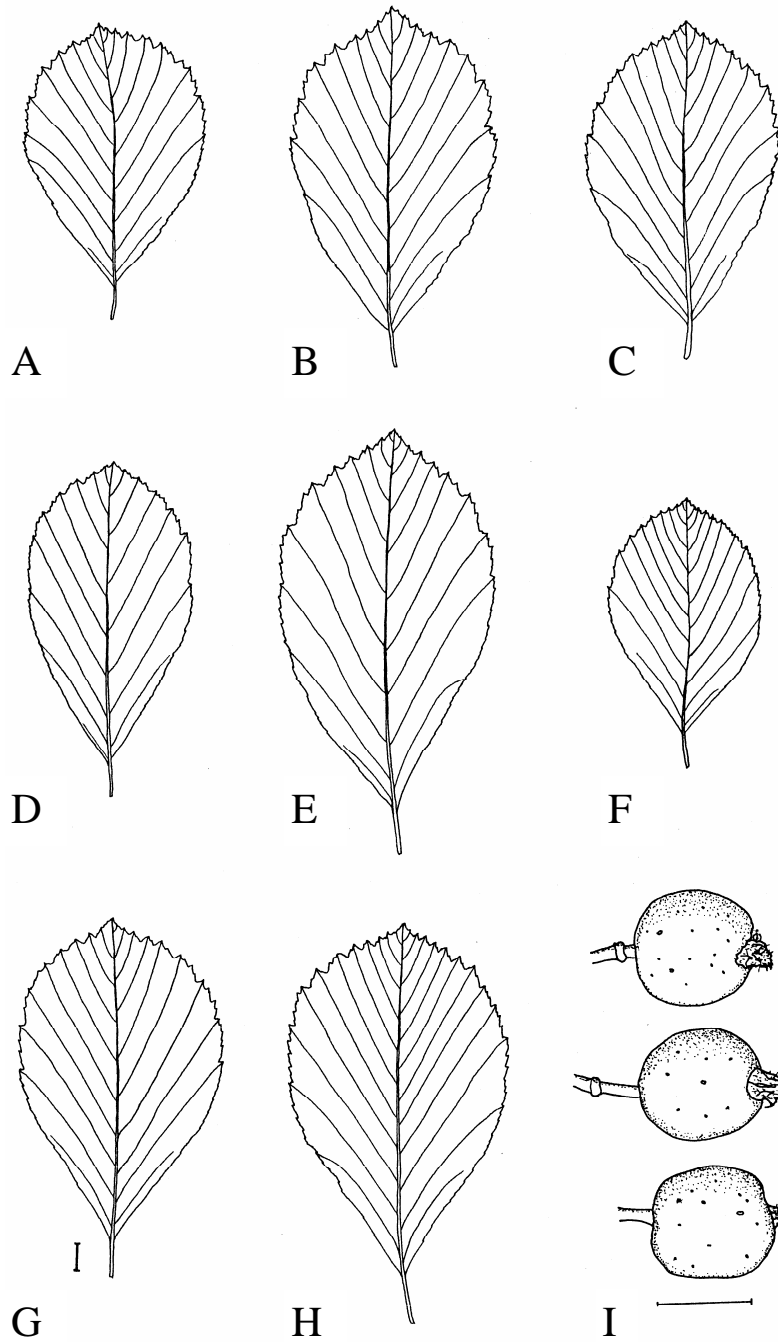


FIGURE 1. *Sorbus whiteana*. A–H, Typical leaves from the short shoots. A, Leigh Woods, Holotype and B–C, Isotype. D, Stokeleigh Camp (NMW.V.2004.26.183). E, Clifton Down, top north edge of Great Quarry (NMW.V.2001.25.240). F, Ban-y-gor (NMW.V.2002.17.103). G, Shorn Cliff (NMW.V.2002.13.164). H, Lady Park Wood (V.2004.11.36). I, Fruits, The Gulley (NMW.V.1998.48.21). Scale bars 1 cm.

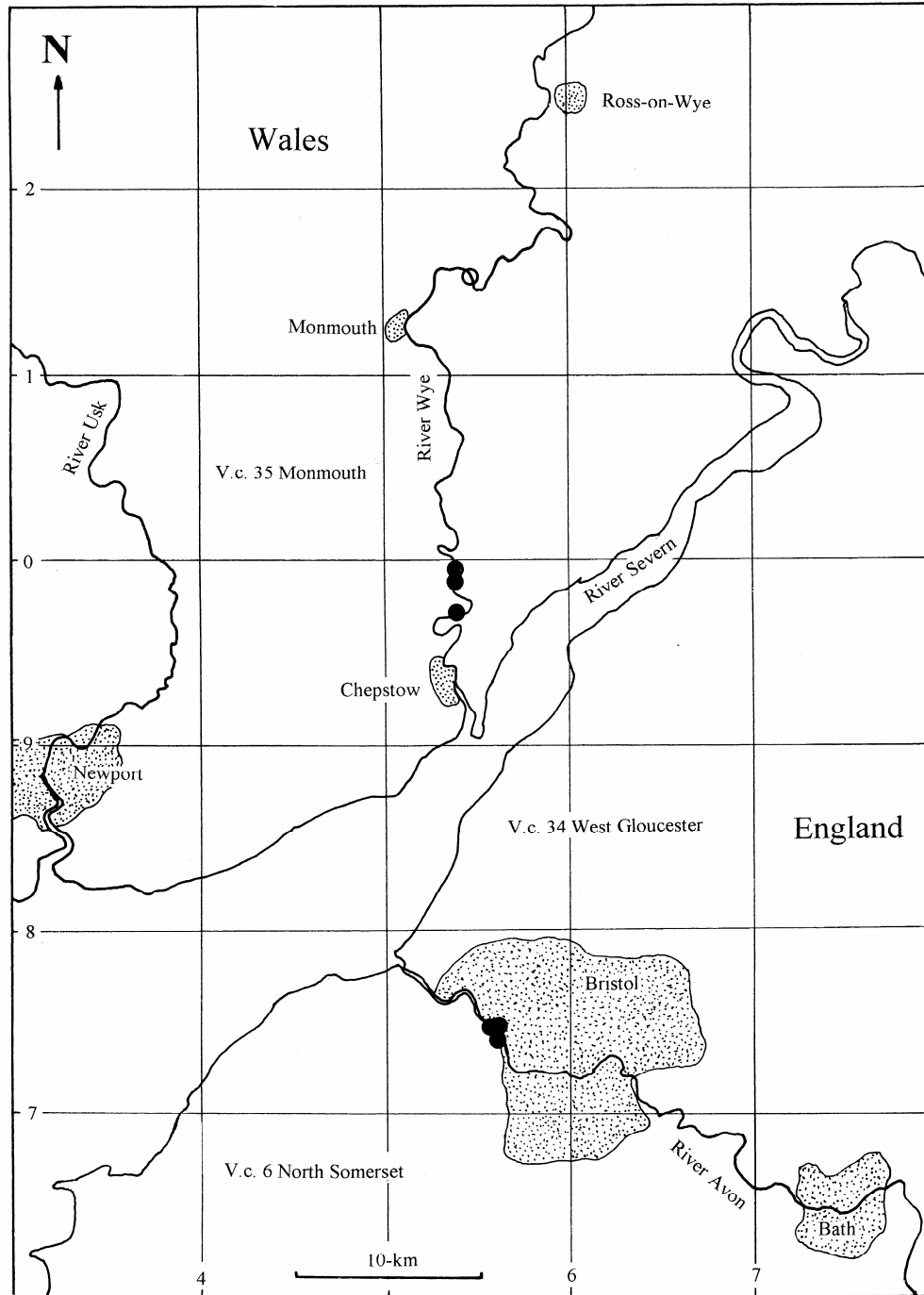


FIGURE 2. Distribution map of *Sorbus whiteana* in South-west England and Wales. ● Confirmed localities, ○ Provisional identification.

cupped, with spreading hairs at base. Stamens *c.* 20, anthers yellow with a pink flush. Styles 2, green, free to base, hairy at base. Largest fruits (9.5–)10–13.5(–14) × (9–)10–13(–14) mm, (0.85–)0.9–1.1(–1.2) times as long as wide, usually looking longer than wide, sometimes globose, widest at the middle, with sparse to fairly frequent, small to moderate-sized lenticels scattered over the surface, sometimes with a few more at the base, red at maturity (RHS guide 44A, 45B, 46A, 46C).

Sorbus whiteana occurs on Carboniferous Limestone rocks and their associated soils on open cliffs, screes and grassland edges, scrub and developing woodland. It is confined to the Avon Gorge, Bristol and the Wye Valley (Figure 2). All the NMW material cited below has been collected by either one or both of us, sometimes with other botanists and colleagues.

V.C. 6 NORTH SOMERSET

Avon Gorge, Leigh Woods, in three places: One tree, cliffs below Stokeleigh Camp, ST5673, 2004 (NMW), second tree nearby, 2005 (NMW); two trees, Donkey Slide, ST5673, 2004 (NMW); one tree, Quarry 3 (former police firing range), ST5574, 2002, 2004 (Holotype; NMW).

V.C. 34 WEST GLOUCESTER

Avon Gorge, Clifton Down: Rocky wooded slope, 1920, J. W. White (K). 13 September 1955, E. F. Warburg (OXF). 24 June 1958, P. J. M. Nethercott (OXF). We have seen it in three places: five trees, Great Quarry, ST5674, 2002, 2003, 2004 (NMW); at least 11 trees, wood north of Great Quarry ST5674, 1997, 2001, 2002, 2004 (NMW) and six more trees, 2005; trees 83 and 101x, north side of The Gulley, ST5674, 1996, 1997 (NMW; Rich & Houston 1996).

A few trees, Ban-y-gor cliffs, Wye Valley, ST5496, 2000, 2002 (NMW).

At least 53 plants, frequently scattered along Shorn Cliff, Tidenham, Wye Valley ST5398, ST5498 and ST5499, 2001, 2002 (NMW; Houston *et al.* 2002).

V.C. 35 MONMOUTH

One plant on cliffs, Lady Park Wood, Wye Valley, SO5414, 2003 (NMW; Houston *et al.* 2004); requires confirmation from fruit.

Thus at least 76 plants of *S. whiteana* are known in four sites (some with subpopulations) in two vice-counties in England, and it may occur in one site in Wales.

DISCUSSION

Sorbus whiteana is characterised by the obovate, cuneate-based, unlobed leaves which are greenish underneath and the red fruits which are generally longer than wide. Being triploid, *S. whiteana* is presumably derived from *S. aria sensu stricto* and another member of the *S. aria* group, either in the Wye Valley or in the Avon Gorge.

Sorbus whiteana is only likely to be confused with the most closely related species in the *S. aria* group in the British Isles. The obovate, cuneate-based leaves which are greenish underneath will distinguish it from most plants of the very variable *S. aria sensu stricto* which tends to have ovate leaves which are cordate to broadly cuneate at the base, and which are always white underneath. *Sorbus whiteana* differs from *S. wilmottiana* in having obovate, unlobed leaves which are greenish underneath; the latter has elliptic, weakly-lobed leaves which are whitish underneath (Rich & Houston 2004). The greenish underside of the leaves also distinguish *S. whiteana* from *S. leptophylla* E. F. Warb., which also has larger, shallowly-lobed leaves and larger fruits, and from *S. vexans* E. F. Warb., which also has relatively narrow leaves. *Sorbus whiteana* is readily distinguished from *S. hibernica* E. F. Warb., *S. lancastricensis* E. F. Warb., *S. porrigentiformis* and *S. rupicola* (Syme) Hedl. in having fruits longer than wide and leaves greener underneath; these four other species have fruits wider than long and leaves whitish underneath.

The complex history of *S. whiteana* in the Avon Gorge is worth setting out as the taxon has been known for some time. It was originally confused with the central European endemic *S. hungarica* (Bornm.) Hedl. ex C. E. Salmon in *Journal of Botany* 68: 174 (1930) (= *S. hungarica* (Bornm.) Kárpáti in *Borbasis Nova* 25: 23 (1944)) which is related to *S. austriaca* (G. Beck) Hedl. (Warburg & Kárpáti 1968). There has also been confusion with *S. wilmottiana*. *Sorbus whiteana* was first collected in the Avon Gorge by the great Bristol botanist James Walter White (1846–1932), in 1920, from a rocky wooded slope on Clifton Down (K; there is no material in J. W. White's herbarium in BRISTM), and our specific epithet commemorates him. The sheets were labelled '*S. hungarica* (Bornm.) Hedl.' by C. E. Salmon, presumably after matching them with similar material named as such by T.

Hedlund from the Wye Valley (Salmon 1930; see also below). Other botanists attempted to collect White's '*S. hungarica*' but all the material traced so-labelled is *S. aria*, e.g. Mrs C. I. Sandwith & Mrs M. L. Wedgwood, 2 June 1931; Mrs C. I. Sandwith & G. Taylor, 20 September 1931 and perhaps more significantly two sheets from Clifton Down collected by E. F. Warburg no. 135, September 1935 (all **BM**) indicating that Warburg had tried to investigate it during his work on *Sorbus*. Warburg visited Clifton Down on several occasions and on 13 September 1955 collected three sheets of material, of which one is *S. whiteana* and two others with narrower, more acute, more deeply lobed leaves are *S. aria* (**OXF**). These sheets were retained in a separate folder at **OXF** labelled '*S. hungarica*' by Warburg, along with another sheet he had collected from Leigh Woods which may be part of the *S. porrigentifolmis* group but which interestingly he had labelled "'*hungarica*' = ? *wilmottiana*". Indeed it is probable that Warburg first discovered *S. wilmottiana* during his investigation of White's '*S. hungarica*', but Warburg does not appear to have come to any firm conclusion about the '*S. hungarica*' before he died in 1966. Warburg appears to have named at least one other *S. whiteana* collection (Clifton Down, 24 June 1958, P. J. M. Nethercott, **OXF**) as *S. wilmottiana*, but the specimen is mixed on a sheet with two genuine collections of *S. wilmottiana*.

In 1996, English Nature commissioned a survey of *Sorbus* of The Gulley, Durdham Down, Bristol (v.c. 34 West Gloucester) to provide information before conservation work was carried out, as The Gulley was thought to be an important site for *Sorbus* (Rich & Houston 1996). During this survey, two plants of *S. whiteana* were found (another tree may be referable to the *S. latifolia* (Lam.) Pers. group) and were shown to P. D. Sell at Cambridge on 10 October 1996; he agreed they did not match any known species. The plants were given the working name *Sorbus* 'JWWhite' for convenience. Specimens were exhibited at the 1996 BSBI Exhibition Meeting (Rich & Houston 1997), which prompted only one comment, i.e. that they were *S. wilmottiana* by P. J. M. Nethercott (this was not surprising in view of the determination by Warburg cited above). Between 1997 and 1999, L. Houston with others found more *S. whiteana* trees below the *S. wilmottiana* type tree on the edge of Clifton Down and collected further specimens, which were then all considered to be part of the variation in *S. wilmottiana* (**NMW**).

In 1996, Elin Lemche began a PhD on *Sorbus* taxonomy at Cambridge and, guided by L. Houston, collected *Sorbus* from the Avon Gorge for analysis using a variety of methods including DNA techniques (Lemche 1999). Amongst the specimens collected were two trees in secondary scrub from the bottom of the Great Quarry (Lemche nos. *aria33* and *aria34*, locality incorrectly cited as Leigh Woods) which had at one time been demonstrated by various botanists as *S. wilmottiana*, although more recently they were known not to be that taxon. In her RFLP analysis, Lemche found that these two trees formed an isolated distinct group and *in-situ* hybridisation with *Malus* probes indicated that they were polyploid with one strong and one weak *S. aria sensu lato* band; she suggested that they were candidates for recognition as a new microspecies (Lemche 1999). However, P. D. Sell had named one as *S. rupicola* (a species not currently known from the Avon Gorge) and the other was treated as *S. aria*.

In 2001, T. C. G. Rich began to extend the work of Lemche (1999) on *Sorbus* taxonomy, using more advanced DNA methods (e.g. Fay *et al.* 2002), and requested to see the *aria33* and *aria34* trees that L. Houston had shown to E. Lemche. The trees were compared against the type tree of *S. wilmottiana*, and then against the 1996 *Sorbus* 'JWWhite' trees (i.e. *S. whiteana*) and were found to be a good match for the latter. Further samples were collected from other trees in the area. It was then apparent that there had been long-standing confusion between *S. whiteana* and *S. wilmottiana*, at least on the Clifton side of the Gorge (see also Lemche 1999). Further detailed studies of *Sorbus* populations on the Leigh Woods side of the Avon Gorge (V.c. 6 North Somerset) by L. Houston in 2001 also clarified that the *S. whiteana* plants did not fit within *S. wilmottiana*.

In the Wye Valley, the history of *S. whiteana* is somewhat simpler. The recent discoveries stemmed from rope access survey work on the cliffs funded by English Nature. It was found on Ban-y-gor cliffs in 2000 (Houston *et al.* 2001), but was not recognised until 2002 after excellent material had been found at Shorn Cliff, Tidenham (Houston *et al.* 2002). One possible plant was found at Lady Park Wood, Monmouthshire in 2002 but requires confirmation from fruit (Houston *et al.* 2003). It has not been found on searches of the other main cliffs on the English side of the Wye Valley (e.g. around Symonds Yat, The Great Doward, Dennis Grove, Wintour's Leap;

Houston *et al.* 2003, 2004); large areas of the Welsh side remain to be surveyed.

Possibly coincidentally, Salmon (1930) had also cited material of *S. hungarica* named by T. Hedlund collected from cliffs at Pen Moel and Tidenham in the Wye Valley (v.c. 34). Hedlund's determination is surprising given that *S. hungarica* is part of the *S. intermedia* group rather than the *S. aria* group. The *S. hungarica* folder in Hedlund's herbarium in UPS contained no British material in 2004, but one sheet, which probably belongs to the *S. porrigentiformis* aggregate, collected by C. E. Salmon (ref. no. H) on 30 July 1920 from Wye Cliffs, Oakwood, Tidenham had Hedlund's determination as *S. hungarica* subsequently crossed out by Hedlund showing that he had later changed his opinion (the duplicate material from Salmon's gatherings in BM is not *S. whiteana* either). Hedlund was at the time regarded as an authority on *Sorbus*, and although he knew the Scandinavian taxa well, he was inconsistent in determination of material from elsewhere in Europe and came to be considered as unreliable (Kovanda 1961

puts it more strongly!). We consider his determinations of British material of *S. hungarica* as erroneous.

Sorbus whiteana qualifies as 'Endangered' under the IUCN (2001) Threat Criteria. There appear to be no immediate threats to its survival provided care continues to be taken during conservation habitat management work in the Avon Gorge. Seed from Clifton Down has been deposited in the Millennium Seedbank and plants are being grown at the National Botanic Garden of Wales and Bristol University Botanic Garden.

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