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Oaks (*Quercus* spp.) parasitised by mistletoe *Viscum album* (Santalaceae) in Britain

John Box*
Telford, UK

*__Corresponding author__: John Box, email: john.box@knowlebox.co.uk

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Abstract
Information on oaks *Quercus* spp. parasitised by *Viscum album* L. in Britain that was obtained in a comprehensive review of the literature and records with site visits from 1996 to 1998 has been updated during 2017 and 2018. Currently there are thirteen confirmed mistletoe-oaks in Britain. *V. album* parasitising *Quercus* spp. mainly occurs at locations in and around Herefordshire in the core of the current and past distribution of *V. album* in Britain. The results of this recent survey accord with the earlier review and with reports in the 19th and early 20th centuries suggesting that the population of between ten and twenty *Quercus* trees parasitised by *V. album* in Britain appears to be relatively stable over time with some losses of host trees and gains from the parasitism of new trees. *Quercus robur* L. is the most frequent host amongst the existing mistletoe-oaks which also include 'red oaks' (*Q. rubra* L., *Q. coccinea* Münchh. and *Q. palustris* Münchh.). The estimated ages of the existing *Quercus* hosts range from 30 to 400 years. The mistletoe-oaks are located in woodland, woodland edges, hedges, parkland, a garden, a churchyard and open countryside by a watercourse.

Keywords: parasitism; pedunculate oak; pin oak; red oak; scarlet oak; sessile oak.

Introduction

Viscum album parasitising *Quercus robur* and *Q. petraea* (Matt.) Liebl. is an uncommon association throughout Western Europe (Tubuef, 1923; Grazi & Urech, 1983; pers. comm., Konrad Urech, August 2017). France appears to be the exception with mistletoe recorded on 390 indigenous oaks (*Q. robur* & *Q. petraea*) and on 463 'American oaks' (*Q. coccinea, Q. palustris* , *Q. rubra*) (Frochot, Grazi & Urech, 1994; Ramm *et al*., 2000; Urech, 2008). At many locations in France, either *V. album* has disappeared from the oak tree or the tree is no longer present and currently there are about 245 indigenous oak trees with *V. album* (pers. comm., Konrad Urech, August 2017).

In Britain, *Quercus* spp. have always been a rare host for *V album* (Evelyn, 1664; Ray, 1677; Withering, 1796; Loudon, 1838; Bull, 1907; Tubuef, 1923; Nicholson, 1932; Perring, 1973). The current and historical status of *Quercus* with *V. album* in Britain was reported by Box (2000) based on a comprehensive survey from 1996 to 1998 involving the published literature, county floras, herbaria, the

Biological Records Centre and local records centres, the County Recorders of the Botanical Society of Britain & Ireland (BSBI) and site visits.

Methods

Additional information to that given in Box (2000) was sought in various ways and confirmed by visits to specific locations. Requests for information were circulated to environmental and biological records centres in Great Britain in August 2017 by the Association of Local Environmental Records Centres (ALERC) and to the BSBI County Recorders through the BSBI *eNews* in January 2018 (http://bsbi.org/wp-content/uploads/dlm_uploads/BSBI-eNews-January-2018.pdf). Wide circulation about this was achieved through the BSBI News & Views blog (http://bsbipublicity.blogspot.com/2018/01/mistletoe-growing-on-oak.html) and via the BSBI Twitter account (https://twitter.com/BSBIbotany) during January 2018.

The original eleven *Quercus* trees with *V. album* recorded by Box (2000) and the additional trees identified by ALERC and the county botanical recorders were visited in winter months between October 2017 and December 2018 (in some cases more than once in different months). The presence or absence of *V. album* berries from a visual inspection using 12 x 25 binoculars determined if the plant was female (Fig. 1) or was assumed to be male (confirmation would have required a careful inspection of flowers). The girth of each of the additional *Quercus* trees supporting *V. album* was measured at 1.3 m above ground level and used to derive the diameter at breast height (dbh) from which the age of each tree was estimated taking into account the species, location and habitat (White, 1998, Table 1a).

Figure 1. *V. album* with berries

Results

The current status of the original eleven *Quercus* trees with *V. album* (Box, 2000) and four new mistletoe-oaks is set out in Table 1. *Q. rubra* is preferred to the synonym *Q. borealis* used in Box (2000). Full descriptions of the locations are not given below and the locations are ascribed to a nearby village or town and the relevant 10 km square (hectad) of the Ordnance Survey national grid.

Table 1. Current status of *Quercus* parasitised by *V. album* in 2017 and 2018

Location **Hectad** **Watsonian vice county**	***Quercus* species**	**Summary description of *V. album***
Brampton Bryan SO 37 Herefordshire (v.c. 36)	*Q. coccinea*	One female bunch at base of main branch close to main trunk at around 15 m in height in parkland tree (1996: dbh 65 cm, estimated age 90 y). Originally recorded as one bunch that was assumed to be male in December 1996 and December 1998.
Bredwardine SO 34 Herefordshire (v.c. 36)	*Q. robur*	Female bunches in four separate locations on a branch and on the main trunk at heights of 9.5 m to 11 m in hedgerow tree (1996: dbh 185 cm, estimated age 300-400 y). Originally recorded as two female bunches in 1996.
Brinsop SO 44 Herefordshire (v.c. 36)	*Q. robur*	Two female bunches on branches at around 10 m and 15 m in height on tree by watercourse in open countryside (1996: dbh 107 cm, estimated age 160-170 y).
Deerfold SO 36 Herefordshire (v.c. 36)	*Q. robur* x *Q. petraea*	The bunch recorded in December 1996 is no longer present. There are two short mature stems which show evidence of being cleanly cut and at least three small, young growths in the same location on the west side of the western of the two upper trunks (1996: dbh 142 cm, estimated age 190-260 y). The position is similar to that depicted by Bull (1869).
Eastnor SO 73 Herefordshire (v.c. 36)	*Q. robur*	Luxuriant growth of female plants on branches and main trunk at around 10 m in height on a woodland tree (1996: dbh 85 cm, estimated age 210-240 y).
Frampton-on-Severn SO 70 West Gloucestershire (v.c. 34)	*Q. robur*	One female bunch with at least five separate stems growing on main branch close to trunk at around 6 m in height in a hedgerow tree (1997: dbh 146 cm, estimated age 250-270 y).

Great Malvern SO 74 Worcestershire (v.c. 37)	*Q. rubra*	Around 14 bunches (half female, half assumed to be male) growing on branches at heights from 2 m to the upper parts of a mature hedgerow tree (2017: dbh 80 cm, estimated age 80-100 y).
Gwehelog SO 30 Monmouthshire (v.c. 35)	*Q. robur*	One bunch assumed to be male growing on main trunk at around 10 m in height at edge of woodland (1997: dbh 97 cm, estimated age 140-150 y).
Huddington SO 95 Worcestershire (v.c. 37)	*Q. rubra*	Three female bunches growing on branches at heights of around 2 m and 3 m in a hedgerow tree (2017: dbh 31 cm, estimated age 30-40 y).
Leintwardine SO 47 Herefordshire (v.c. 36)	*Q. rubra*	Four female bunches on separate branches at heights of around 2 m to 6 m. Only one female bunch was present in December 1996 on this churchyard tree (1996: dbh 63 cm, estimated age 90 y).
Penallt SO 50 Monmouthshire (v.c. 35)	*Q. rubra*	One female bunch with multiple main stems on two adjacent branches at a height of around 7 m on woodland edge (2018: estimated age 60-70 y).
Putley SO 63 Herefordshire (v.c. 36)	*Q. rubra*	Tree felled around 2000 because of disease (pers. comm., Ray & Elizabeth Hunter, November 2017).
Sheffield SK 38 South-west Yorkshire (v.c. 63)	*Q. palustris*	One female bunch growing on top of branch in angle with trunk at a height of around 3 m in a park (2018: dbh 26 cm, estimated age 30 y).
Stretton Sugwas SO 44 Herefordshire (v.c. 36)	*Q. robur*	Tree present. Branch with *V. album* was sawn off prior to April 2012 (pers. comm., Tony Titchen, April 2012) by power supply company because of proximity to overhead power lines (pers. comm., Richard Morgan-Jones, November 2017).
Windsor SU 96 Berkshire (v.c. 22)	*Q. rubra*	Three female bunches growing on branches at around 6 m and 10 m in a park (1997: dbh 81 cm, estimated age 115 y). Originally recorded as one bunch assumed to be male in January 1997 and November 1998.

Additional locations and information concerning *Quercus* parasitised by *V. album* to that in Box (2000) are set out below in order of the Watsonian vice-counties.

Dorset (v.c. 9)

Chalbury Dorset Environmental Records Centre (DERC) has a record from April 2014. This was determined in January 2018 to be on lime (*Tilia* sp.) and the record will be revised (pers. comms., Martin Rand and Robin Walls).

Shillingstone DERC has records from three separate locations from 2000 and 2016. These were checked in February 2018 and are either no longer present (2000 record) or are not on oak (2016 records) and the records will be revised (pers. comms., Carolyn Steele and Judith Crompton).

South Hampshire (v.c. 11)

Braishfield Hampshire Biodiversity Information Centre has a record from May 2012 "On Oak (*Quercus robur*) - several trees, east side of road". A site visit in January 2018 confirmed that tufts of atypical twigs were misidentified as *V. album* and the original record will be revised (pers. comm., Martin Rand).

East Kent (v.c. 15)

Boxley The BSBI Database and the Kent & Medway Biological Records Centre have a record from March 2010 (pers. comm., Geoffrey Kitchener). The host tree was determined as field maple (*Acer campestre*) by inspection in February 2018 (John Box) and exchange of photographic evidence with the original recorder; the record in both databases will be revised (pers. comm., Geoffrey Kitchener, February/March 2018).

Sheldwich The BSBI Database and the Kent & Medway Biological Records Centre have a record from January 2011; the host tree has been checked by the original recorder, determined to be lime (*Tilia* sp.) and the record in both databases will be revised (pers. comm., Lliam Rooney, January 2018).

Bedfordshire (v.c. 30)

Wilstead Recorded in March 2006 by Bedfordshire Natural History Society as one medium clump of *V. album* on *Quercus*. Location checked in February 2018 but no *V. album* was seen on the trees (pers. comm., Jackie Ullyett, Bedfordshire and Luton Biodiversity Recording and Monitoring Centre).

Monmouthshire (v.c. 35)

Llanover South East Wales Biodiversity Records Centre (SEWBReC) has a record from January 2015 "'?oak tree with moderate clumps". A site visit in November 2018 confirmed the host as sycamore (*Acer pseudoplatanus*) and the original record will be revised (pers. comm., Jerry Lewis).

Mamhilad Titcombe (2018) refers to *V. album* on *Q. palustris* at the side of the A4042 in the Little Mill/Mamhilad area; this was a large bunch when recorded in August 2012 that has not been seen for the past couple of years (pers. comm., Colin Titcombe, December 2018). My visit in December 2018 with Colin Titcombe located the tree but no mistletoe was visible.

Penallt *V. album* on "red oak (*Q. borealis*)" recorded by Colin Titcombe in February 2009 (SEWBReC). Reported on red oak (*Q. rubra*) (Titcombe, 2018).

Visits on 5 & 16 December 2018: Mature *Q. rubra* growing on woodland edge. The tree is divided into two trunks almost from the base and the dbh cannot be measured in order to estimate age. The tree is in a line of red oaks and the two adjacent trees to the west were used as proxies with dbh of 56 cm and 59 cm at 1.3 m and estimated ages of around 60-70 years. A large straggly female bunch of *V.album* growing from multiple attachments to two upper branches on eastern side of trunk at approximately 7 m above ground level.

Worcestershire (v.c. 37)

Great Malvern Recorded in a garden in SO74 in April 2008 "On *Quercus rubra*, more plants on similar trees in back garden (no access)" (pers. comm., John Day, August 2017).

Visits on 5 October & 14 November 2017: Healthy, mature *Q. rubra* with a spreading crown growing in a hedgerow between a road and a private garden. The dbh is 80 cm at 1.3 m and the estimated age is 80-100 years. Around six to seven female bunches and six to seven bunches assumed to be male ranging in size from large to small growing on branches at various heights from approximately 2 m above ground level to the upper parts of the tree. One bunch of what appeared to be dead *V. album* attached to a dead branch.

Huddington Recorded in March 2002 in SO95 "Large clump 3.5m up at junction at first main branch. Host juvenile tree approximately 7 m high and 0.47 m girth breast height" (pers. comm., John Day, August 2017).

Visit on 5 October 2017: Healthy, young *Q. rubra* growing in a hedgerow. The dbh is 31 cm at 1.3 m and the estimated age is 30-40 years. Three large female bunches growing on branches at approximately 2 m and 3m above ground level.

Worcestershire (v.c. 37) & Shropshire (v.c. 40)

Bewdley Three historical reports on the north bank of the Dowles Brook at Bewdley were noted by Box (2000). A visit to the location in December 1996 found that there was no *V. album* present on this *Quercus* tree. Another visit in July 2017 confirmed the absence of *V. album* on this *Quercus* and on the very old pollarded *Quercus* opposite on the south bank of Dowles Brook. The location of the *Quercus* on the north bank was ascribed by Box (2000) to Worcestershire (v.c. 37) although it should be Shropshire (v.c. 40) following a close examination of the boundary between the two vice counties (the vice-county boundary tool http://www.cucaera.co.uk/grp/ on the BSBI website www.bsbi.org/maps-and-data).

Staffordshire (v.c. 39)

Arley Rea (1923) reports *V. album* on *Q. rubra* at Arley Castle. A report of *V. album* on one *Q. rubra* in Worcestershire by Maskew (2014) is based on data from a field meeting of the Wyre Forest Study Group to Arley Castle in January 2013 (pers. comms., John Hawksford, August 2017 and Brett Westwood, September 2017). Arley Castle is in the administrative county of Worcestershire but in v.c. 39 Staffordshire. My visits in November 2017 and February 2018 found no *V. album* on the *Q. rubra* at the reported locations.

Shropshire (v.c. 40)

Hughley My visit in January 2018 to the location (National Grid Reference SO 565966) of a field named as 'Mizzletoe Oak' on the map redrawn by HDG Foxall in 1977 from the 1839 tithe map and apportionment of Hughley parish in Shropshire (held by Shropshire Archives, Shrewsbury) found that the hedges have been altered and that no *V. album* was growing on the nearby *Quercus* trees.

Nottinghamshire (v.c. 56)

Wallingwells Under the heading 'Unknown locations', Box (2000) noted a report of three *V. album* plants on *Quercus* seen by Thomas Knowlton in August 1765 on the estate of …. White Esq. at Watling Wells (Dillwyn 1843) but this location could not be identified. Further research revealed an earlier account by Thomas Knowlton in a letter dated 20 January 1741 of *V. album* growing on *Quercus* that refers to Walling Wells (Henrey 1986), now known as Wallingwells, near Worksop.

Enquiries of Carlton in Lindrick Parish Council and Woodsetts Local History Society in 2017 and my visit to one potential location in February 2018 produced no positive results.

South-west Yorkshire (v.c. 63)

Sheffield *V. album* reported growing on a young planted *Quercus* in February 2017 (Sheffield Biological Records Centre). Tree confirmed as *Q. palustris* from leaves in October 2017 (pers. comm., Michael Senkans, Parks & Countryside Service, Sheffield City Council).

Visit on 20 January 2018: Young *Q. palustris* growing in a park. The dbh is 26 cm at 1.3 m and the estimated age is around 30 years (26-33 years). One female bunch of *V. album* with berries growing on top of a lower branch in the angle with the trunk at approximately 3 m above ground level.

Discussion

A further four *Quercus* trees parasitised by *V. album* (Fig. 2) have been identified during 2017 and 2018 in addition to the eleven parasitised trees recorded by Box (2000) between 1996 and 1998. Of these original eleven trees, one has been felled (Putley) and one has lost the branch supporting *V. album* (Stretton Sugwas). There were more bunches of *V. album* growing on the trees at Bredwardine, Leintwardine and Windsor than were reported in 2000. There are now thirteen *Quercus* trees parasitised by *V. album* in Britain.

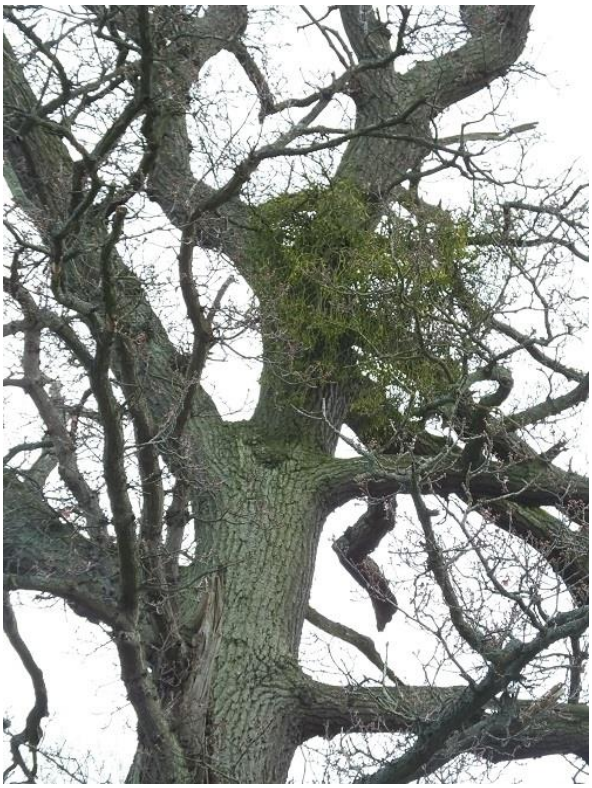

Figure 2. A straggly bunch of *V. album* parasitising *Q. robur*

The four recently recorded *Quercus* trees with *V. album* are growing in open situations (hedgerow, woodland edge, urban park, garden) which is consistent with those reported by Box (2000). The lower end of the age range of the original set of eleven trees (90 to 400 years) has been reduced to around 30 years, at least for red

oaks, because of the new records at Huddington and Sheffield. The age of the *V. album* cannot be reliably estimated and the date of initial parasitism is unknown.

Viscum album is dioecious. Box (2000) reported that the *V. album* on three *Quercus* trees (Brampton Bryan, Gwehelog, Windsor) was recorded as 'probably male' because of the absence of berries in visits during November to February. There were no *V. album* berries visible on the tree at Gwehelog in November 2017 and the *V. album* is once again assumed to be male. However, berries were clearly visible on various parts of the *V. album* growing on *Quercus* at Brampton Bryan and at Windsor in November 2017, although no berries were visible on the previous visits to the *Quercus* trees at Brampton Bryan (December 1996, December 1998) and at Windsor (January 1997, November 1998) (Box 2000). This suggests that the *V. album* plants at both Brampton Bryan and Windsor are female but may lie at sufficient distance from the nearest male *V. album* that pollination does not always occur.

The *V. album* on the *Quercus* at Deerfold is notable because it has a very long recorded history. Bull (1869) includes a sketch of a bunch of *V. album* on a tree without leaves in March 1869 together with a description of it growing on a main stem of the tree after it has bifurcated; Anon. (1930) reports the *V. album* growing in the same location; a record from the national Biological Records Centre states "Extinct c. 1963"; Tonkin (1984) reported that the *V. album* was no longer there; Box (2000) recorded a bunch of *V. album* in 1996 on the west side of the western of the two main trunks which divided at about 6.5m above ground level; there was a report by Jonathan Briggs of no visible *V. album* in February 2011 (https://mistletoematters.wordpress.com/2011/02/25/mistletoe-oaks-revisited/); my visits in November 2017 and February 2018 found no bunch of *V. album* but there were at least two short mature stems with clean cut ends and three small, young growths (Fig. 3) growing in the same position on the trunk as that depicted by Bull (1869). *V. album* has been recorded since 1869 growing in the same position on one of the two main stems or trunks of this tree, but the *V. album* was not present as a bunch around 1963, in 1984, in 2011 and was only present as small plants in winter 2017/18. Natural processes may have been involved (such as death or being blown off in a storm), but the recent evidence of cut ends to the main stems strongly suggests that the *V. album* was harvested by humans. *V. album* regrows as adventitious shoots from endophytic haustoria (Harley, 1863, page 185; Zuber, 2004, pages 182-183). The past reports of an absence of *V. album* may have been due to small, young regrowths not being visible from the ground.

Full descriptions of the locations of *Quercus* with *V. album* are not given in this paper because there have been financial offers to reveal such locations, especially on indigenous oaks (*Q. robur* and *Q. petraea*). *V. album* is claimed to be an alternative therapy for cancer (for example, Mistletoe Therapy UK, http://www.mistletoetherapy.org.uk/) and is one of the most widely studied complementary and alternative medicine therapies for cancer (for example, National Cancer Unit, USA, https://www.cancer.gov/about-cancer/treatment/cam/patient/mistletoe-pdq). *V. album* has been tested extensively as a treatment for cancer, but randomised controlled trials fail to show benefit (Ernst 2006).

Figure 3. Mature *V. album* stems that have been cut and small adventitious shoots on the Deerfold tree

Quercus trees supporting *V. album* mainly occur in and around Herefordshire in the core of the current and past distribution of *V. album* in Britain (National Biodiversity Network Atlas https://spatial.nbnatlas.org/?q=lsid%3ANBNSYS0000003624; Briggs, 2011, page 24, Fig. 1; Perring 1973, page 143, Fig. 7). This geographical distribution has not yet been fully explained although climatic factors are considered to be very important in the distribution of *V. album* (Iversen, 1944; Perring, 1973; Briggs, 1991; Zuber, 2004). It is interesting to note that this core area is associated with the river basin district of the lower part of the river Severn (Environment Agency, 2016, page 12 & Fig. 1) and this apparent association would merit further investigation.

The results of the 2017/18 survey of *V. album* parasitising *Quercus* accord with the conclusion of Box (2000), based on field data from 1996-1998 and reports in the l9th and early 20th centuries, that there is a population of between ten and twenty *Quercus* trees with *V. album* in Britain. This population appears to be relatively stable over time with some losses of host trees (or branches) with *V. album* and gains from the parasitism of new *Quercus* trees.

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