



fig. 1 A selection of fifteen *Hygrocybes* found in Slaugham Churchyard

Waxcap Grasslands in Sussex

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Waxcap Grasslands

Hygrocybes are a genus of fungi that grow in soil, and are one of several groups of macrofungi that have their major habitat in old unimproved grassland (although in other parts of the world such as North America they are mainly found in woodland) [Boertmann, 1995]. These groups include the *agaric* genera *Entoloma* (fig. 2) and *Dermoloma*; the *Clavariaceae* (fairy clubs) especially *Clavaria* and *Clavulinopsis*; and the *Geoglossaceae* (earth tongues) (fig.3).

Because many *Hygrocybe* species are brightly coloured in red, orange, or yellow they can be a conspicuous element of such vegetation during their fructification period. Indeed the terms Waxcap grasslands or *Hygrocybe* meadows are widely used to describe grassland sites that have a high species richness in the above fungal groups [Rotheroe, 1999].

Waxcap grasslands are not a single grassland type and could occur in several communities recognised by the National Vegetation Classification. Typical Waxcap grassland tends to have a low availability of nitrogen and phosphorus, with a low-intensive use for hay production or grazing, and a long, unchanged agricultural use. Such grassland often has a short turf with a well-developed bryophyte community [Keizer, 1993].

The flora of vascular plants in Waxcap grasslands is usually very diverse, although this is not always true, as in many cases of road verges, old cemeteries, churchyards, and lawns. Indeed

surveys of semi-natural grassland that focus solely on the diversity of the vascular plants may well overlook sites with a high diversity of the fungal flora. In many grassland types the number of fungal species exceed the number of vascular plants [Keizer, 1993]

Conservation of Waxcap Grasslands

Unimproved grassland is an endangered habitat in the UK. Since 1945 we have lost 95 per cent of our hay meadows and 80 per cent of our chalk pasture. Much of the grassland has been treated with selective herbicide, fertilised, ploughed, and reseeded, so that the complex communities of native plants were replaced with monocultures of domesticated strains of grass. This picture is repeated across Europe with other countries suffering even greater loss and destruction of the habitat [Rotheroe 1999].

In areas of intensive agriculture, survival of such grassland is limited. In general they are confined to rocky ground and steep slopes. Elsewhere their survival is just a matter of chance, perhaps where a farmer has adopted a less intensive regime, or in refuges such as old churchyards.

In the UK there are large tracts of hill turf used primarily for sheep grazing and these may include areas of Waxcap grassland. The better sites are often on thin soil, sometimes associated with past disturbance, e.g. along ancient trackways and by old mines and quarries. However, except on limestone and ultrabasic rocks such as basalt and serpentinite, these hill grasslands may be too nutrient poor to support many of the rarer species.

Application of fertilisers will completely change the fungal flora in favour of more nitrophilous species. All the fungal species from the groups mentioned above will disappear and will be replaced by trivial species from groups like *Clitocybe*, *Conocybe*, *Panaeolus*, and *Coprinus*. Some *Hygrocybe* species seem to be more tolerant to fertilizers than other species. In fields abandoned for about 10 years *H.virginica* and *H.conica* and a few other *Hygrocybe* species may appear, while others such as *H.punicea* is exclusively found in grasslands with a very long continuity as unfertilised grassland [Boertmann, 1995]



fig. 2 *Entoloma bloxamii* in Bexhill Cemetery



fig. 3 *Geoglossum fallax*, *Microglossum olivaceum*, and *Geoglossum umbratile* in Danehill Churchyard

If grazing terminates, tall grasses such as *Dactylis glomerata* will become dominant, and later the area will gradually turn into scrub. Many of the characteristic grassland fungi may still occur in the scrub phase, particularly on naked soil under deciduous shrubs. Some of the grassland *Hygrocybe* species also occur in forests, particularly on naked, rich soil [Boertmann, 1995].

Some of the species of the fungal groups mentioned above occur in the British Fungal Red Data List (RDLs) of threatened or endangered species, but considerably more figure in many of the 11 published national RDLs in Europe [Arnolds & de Vries, 1993]. 89 per cent of *Hygrocybe* species occur on at least one RDL, along with all European species of *Clavaria*, 67 per cent of *Clavulinopsis*, and 97 per cent of *Entoloma*. Three grassland fungi are among the 13 priority species of the UK Biodiversity Group: *H.spadicea*, *H.calyptiformis*, and *Microglossum olivaceum*.

Survey of Waxcap Grasslands

Despite this concern for the conservation of such fungi, they are seldom used as a criterion for the selection and notification of SSSIs. The principal reason for this is the lack of data about the fungal flora of grassland sites. Most published mycota relate to woodlands, and many records such as those in the British Mycological Society (BMS) database are fragmentary and not site orientated. In the light of this absence of data, in 1996 the BMS initiated a survey throughout the UK of the fungi characterising unimproved, grazed grassland [Rotheroe, Newton, Evans & Feehan, 1996]. This article summarises the results of the survey in Sussex performed by the West Weald Fungus Recording Group (WWFRG).

In this survey of Sussex, the emphasis has so far been on the *Hygrocybe* genus, as most of the *Entoloma* genus require a considerable amount of expertise to identify. The nomenclature followed for the *Hygrocybe* group has been that of Boertmann (1995). He has adopted a species concept which is wider than that of many other authors such as Bon, Courtecuisse, and Moser [Boertmann, 1995].

Species results

So far in this survey, 39 taxa of *Hygrocybe* have been recorded from 98 sites. There are probably some other taxa present that have yet to be found. There are 52 taxa that grow in habitats similar to those found in Sussex (i.e. excluding those restricted to arctic/alpine habitats), and some of these ought be in Sussex (e.g. *H.fornicata* or *H.splendissima*)

When the national survey was started in 1996, it was thought the status of the Pink Waxcap (*H.calyptiformis*) was rare, and it was one of the 13 priority species of the UK Biodiversity Group. The fact that the author of *The Genus Hygrocybe*, David Boertmann had never seen a fresh specimen until he gave a mycological workshop in Wales in 1997, indicates its rarity in Europe. However the results of this survey have shown it to be far more frequent than initially thought and we have recorded it from 23 out of 98 sites in Sussex. In fact it is one of the more common *Hygrocybe* taxa as 27 of the 39 taxa have been found in fewer sites. Britain is a stronghold for this species in Europe.

H.spadicea is the other species on the priority list and like the Pink Waxcap is easily identifiable in the field with its dark brown pileus contrasting with its yellow lamellae and stipe. However, unlike *H.calyptiformis*, this has only been recorded once at the frequently visited Ashburnham place so it is a relatively rarer species.

There are a number of other species that have only been recorded once or twice (or three times), as can be seen from the list of the 12 rarest species:

| Fungus name | No. of sites |
|--|--------------|
| <i>H.nitrata</i> | 1 |
| <i>H.conica</i> var. <i>chloroides</i> | 1 |
| <i>H.glutinipes</i> var. <i>rubra</i> | 1 |
| <i>H.spadicea</i> | 1 |
| <i>H.vitellina</i> | 1 |
| <i>H.radiata</i> | 1 |
| <i>H.ovina</i> | 1 |
| <i>H.psittacina</i> var. <i>perplexa</i> | 1 |
| <i>H.colemanniana</i> | 2 |
| <i>H.subpapillata</i> | 2 |
| <i>H.persistens</i> var. <i>persistens</i> | 2 |
| <i>H.phaeococcinea</i> | 3 |

Some of these species may be rare because they are small, difficult to identify, and easily overlooked. For example *H.phaeococcinea* and *H.subpapillata* are species that have only recently been found in the UK: they are small and unless fresh can easily be mistaken for other species. (St Dunstan s farm is a good site for both these species as well as most other Small Red Jobs .)

Other species are, however, easily identifiable yet are still rare, for example *H.ovina* is large and looks like a sculptured cowpat, but has only been recorded from one site at North Chailey. *H.vitellina* is one of the smallest taxa but is unmistakable with its persistently viscid pileus and stipe, but again has only been recorded at one site at Slaugham.



fig. 4 *Hygrocybe conica* var. *chloroides* found at Camber Sands

Other species are rare purely because of the rarity of their habitat. *H.conica* var. *chloroides* (fig 4) is a very attractive red form of the common Blackening Waxcap but is restricted to coastal dunes. There are few places in Sussex where these occur or where there is easy access, but they have been recorded along the footpath crossing Camber Sands Golf Course.

One mystery is why some species are rare in Sussex but common elsewhere. For example *H.persistens* has only been recorded from 2 sites in Sussex, and *H.miniata* (fig 5) from only 5.



fig. 5 *Hygrocybe miniata*

In contrast to the rarer taxa there are some that are found in most Waxcap grasslands. The following 4 species have been found in over 50 per cent of the sites surveyed and frequently they are the only species found. Such species are not necessarily indicators of old grassland and indeed I have seen them lining the road verges of the A272.

| Fungus name | No. of sites |
|--|--------------|
| <i>H.chlorophana</i> | 50 |
| <i>H.conica</i> | 50 |
| <i>H.psittacina</i> var. <i>psittacina</i> | 59 |
| <i>H.virginea</i> var. <i>virginea</i> | 62 |

Some taxa are only found in the most sites rich sites. Some of these are easily identifiable in the field so perhaps their presence is the best indicator of good Waxcap grassland. The best of these is perhaps *H.punicea*. This is in general our largest Waxcap, characterised by the dark red and lubricious to viscid pileus and the coarsely fibrillose and cylindrical stipe.

Site Results

When the BMS started its survey, the concept of what good Waxcap grassland was based on the experience of continental mycologists. A simple concept was that a site containing more than 22 *Hygrocybe* taxa was a site of international importance for conservation. As of April 2003, 12 such sites had been recorded in England and 14 in Wales. This shows that despite all the loss of our unimproved grassland in the country, we are one of the European strongholds for Waxcaps. The

best site in England is currently Longshaw Estate with 33 taxa, whilst Garn Ddyrys ironworks heads the Welsh list with 32 taxa

The following table lists the top 20 sites surveyed in Sussex. Most of these sites have been frequently visited so the chances of finding many more taxa are remote. One notable exception is Beauport Park Hotel which has been surveyed only once during the autumn of 2002, which was one of the worst seasons for recording fungi for years.

Top of list is St Dunstan s Farm with 23 taxa (fig 6). This might indicate that the farm consists of old unimproved meadows. There is one part of a large field that consistently yields some of the rarest taxa to be found in Britain. However for 3 years in the 1980 s this field was ploughed and fertilised. Also from aerial photographs from the 1940 s it is clear this field was not a meadow but heathland, and from earlier tithe maps it was a wood not heathland. Similar tales could be told about some of the other rich sites. Danehill Churchyard was not a Churchyard at all 100 years ago; the old church burnt down and was relocated to the new site. Part of Slaugham Churchyard was a public house in the 1920s.

| Site name | No. of <i>Hygrocybes</i> |
|-----------------------|--------------------------|
| St Dunstan s Farm | 23 |
| Danehill Church | 21 |
| Slaugham Church | 21 |
| Walstead Cemetery | 21 |
| Isle of Thorns | 19 |
| Ashburnham Place | 17 |
| East Hoathly Church | 17 |
| Old Heathfield Church | 16 |
| Staplefield Church | 16 |
| Warbleton Church | 16 |
| Bexhill Cemetery | 15 |
| Ebernoe Church | 15 |
| Fittleworth Church | 15 |
| Haywards Heath Church | 14 |
| Hurstmonceaux Castle | 14 |
| Beauport Park Hotel | 13 |
| Brightling Church | 13 |
| Hadlow Down Church | 13 |
| Horsebridge Cemetery | 13 |
| Willingford Farm | 13 |

One major problem with a survey of this kind is that the absence of carpophores (fruit bodies) does not mean an absence of the fungi. If a site visit produces no species, it does not mean that there are no fungi present, it may merely mean that the fungi were not producing carpophores at the time of the visit. There are several reasons for this. Fructification is very dependent upon the amount of precipitation and frost. In very dry seasons the fungi may develop few carpophores or none at all. Additionally, different species produce carpophores at different times of the year;

H.helobia or *H.citrinovirens*, for example, are early species, while *H.russocoriacea* is a late species.

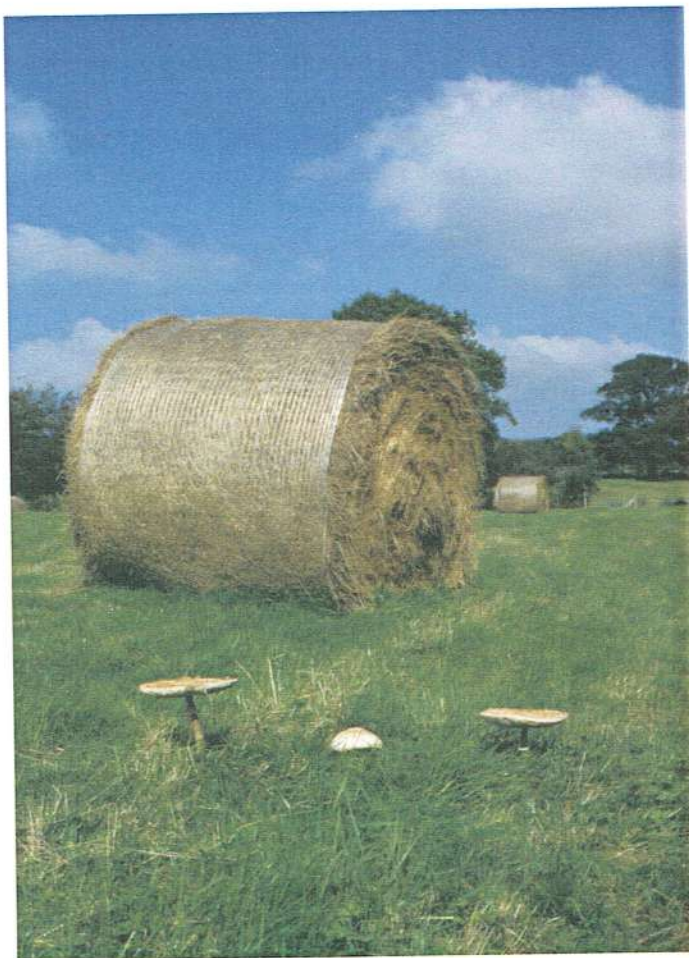


fig. 6 St Dunstan s Farm

Most of the 98 sites surveyed have been churchyards. One of the original intentions of the survey was to try to cover the whole county and the easiest way to do that was to survey all the Churchyards, as these are easily located on the map. However old lawns, such as those found in churchyards, seem to be very good habitats for Waxcaps. Whereas old meadows may have as high a diversity they are very often scattered over larger distances and have a much patchier distribution (e.g. St.Dunstan s Farm).

Most of the good Waxcap grasslands surveyed have also had a good assemblage of vascular plants. In fact the presence of species such as *Orchis morio* in spring is an indicator a good fructification of fungi in autumn. However some of the best sites do not have any particularly good vascular plants. The Isle of Thorns Field Centre on Ashdown Forest (now sadly sold and degraded) is a good example. The playing fields were actually fertilised 3 times a year, but rare species such as *H.flavipes* could be found fruiting around the penalty spot. Slaugham Church is another good example where there are no particularly good vascular plants, but a wealth of Waxcaps.

Most habitats and regions have produced good Waxcap Grasslands. The biggest exception is the Chalk Downland. There are certain *Hygrocybe* taxa that are characteristic of lime rich soil but have not been found in Sussex (e.g. *H.calciphila*). None of the churchyards on the Downland has produced good sites, although *H.colemanniana* has been found at one site on Newtimber Hill. The problem is away from old lawns, a large area needs to be surveyed in which there is a relative paucity of fruiting, and consequently fungi are difficult to find.

Urban areas have yielded some good sites. Haywards Heath Churchyard along the main street is a good example; another is Heene Cemetery in Worthing. Village Greens such as Rushlake Green

and Ebernoe Common can be surprisingly good even with the attention of village fairs, and heavy rollers on the cricket pitches.

This is far from a comprehensive survey of all semi-natural grassland sites in Sussex. Given the number of recorders and the short, uncertain times of fructification, the number of sites visited has been limited. An attempt has been made to include sites from across the counties and to include different vegetation types, but visits are naturally biased to sites nearer to the homes of the recorders. Sites have been selected for survey based on the likelihood of having a good fungal flora. These have either been sites known to be rich in vascular plants or refuges such as churchyards.

There are undoubtedly many good sites waiting to be discovered. One habitat still outstanding is the lawns of old houses and stately homes. In the rest of Britain these have proved to be amongst the richest sites, but many have not yet been surveyed in Sussex, mainly due to the issue of getting access. The author would be very interested to know of any such sites.

All photos in this article were provided by Peter Russell.

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Appendix 1. Count of *Hygrocybe* taxa by site

| Fungus name | No. of sites |
|--|---------------------|
| <i>H.aurantiosplendens</i> | 13 |
| <i>H.calyptiformis</i> | 23 |
| <i>H.cantharellus</i> | 11 |
| <i>H.ceracea</i> | 46 |
| <i>H.chlorophana</i> | 50 |
| <i>H.citrinovirens</i> | 10 |
| <i>H.coccinea</i> | 49 |
| <i>H.colemanniana</i> | 2 |
| <i>H.conica</i> | 50 |
| <i>H.conica</i> var. <i>chloroides</i> (fig 4) | 1 |
| <i>H.flavipes</i> | 9 |
| <i>H.glutinipes</i> var. <i>glutinipes</i> | 23 |
| <i>H.glutinipes</i> var. <i>rubra</i> | 1 |
| <i>H.helobia</i> | 7 |
| <i>H.insipida</i> | 37 |
| <i>H.intermedia</i> | 15 |
| <i>H.irrigata</i> (fig 7) | 29 |
| <i>H.laeta</i> | 10 |
| <i>H.miniata</i> (fig 5) | 5 |
| <i>H.mucronella</i> | 9 |
| <i>H.nitrata</i> | 1 |
| <i>H.ovina</i> | 1 |
| <i>H.persistens</i> var. <i>persistens</i> | 2 |
| <i>H.phaeococcinea</i> | 3 |
| <i>H.pratensis</i> var. <i>pallida</i> | 5 |
| <i>H.pratensis</i> var. <i>pratensis</i> | 36 |
| <i>H.psittacina</i> var. <i>perplexa</i> (fig 8) | 1 |
| <i>H.psittacina</i> var. <i>psittacina</i> | 59 |
| <i>H.punicea</i> (fig 9) | 16 |
| <i>H.quieta</i> | 29 |
| <i>H.radiata</i> | 1 |
| <i>H.reidii</i> | 19 |
| <i>H.russocoriacea</i> | 15 |
| <i>H.spadicea</i> | 1 |
| <i>H.subpapillata</i> | 2 |
| <i>H.virginea</i> var. <i>fuscescens</i> | 6 |
| <i>H.virginea</i> var. <i>ochraceopallida</i> | 5 |
| <i>H.virginea</i> var. <i>virginea</i> | 62 |
| <i>H.vitellina</i> | 1 |



fig. 7 *Hygrocybe irrigata* in Slaugham Churchyard



fig. 8 *Hygrocybe psittacina* var. *perplexa* in Old Heathfield Churchyard



fig. 9 *Hygrocybe punicea*

Appendix 2. Count of sites

| Site name | Grid ref | Vice county | Hygro.Count |
|--|----------|-------------|-------------|
| Ashburnham Place | TQ693143 | 14 | 17 |
| Ashdown Cricket Ground | TQ448328 | 14 | 4 |
| Ashdown Forest | TQ443327 | 14 | 1 |
| Ashdown Forest (Wych Cross) | TQ416310 | 14 | 1 |
| Balcombe Church | TQ307309 | 14 | 5 |
| Battle Cemetery | TQ752162 | 14 | 2 |
| Beauport Park Hotel | TQ792134 | 14 | 13 |
| Bedelands Farm | TQ318204 | 13 | 10 |
| Bexhill Cemetery | TQ725094 | 14 | 15 |
| Bodiam Church | TQ783262 | 14 | 2 |
| Bolney Church | TQ262227 | 13 | 1 |
| Bolney Cricket Ground | TQ263227 | 14 | 7 |
| Boxgrove priory | SU908075 | 13 | 2 |
| Brede Levels | TQ827174 | 14 | 1 |
| Brightling Church | TQ684210 | 14 | 13 |
| Brighton Extra Mural Cemetery | TQ328057 | 14 | 3 |
| Buxted Church | TQ486231 | 14 | 4 |
| Camber Sands Golf Club | TQ950190 | 14 | 4 |
| Cockhurst Church | TQ201298 | 13 | 2 |
| Colgate Church | TQ231328 | 13 | 11 |
| Crowlink | TV545970 | 14 | 8 |
| Dallington Church | TQ658191 | 14 | 6 |
| Danehill Church | TQ402276 | 14 | 21 |
| East Hoathly Church | TQ520162 | 14 | 17 |
| East Lavant Church | SU862085 | 13 | 2 |
| Ebernoe Church | SU976278 | 13 | 15 |
| Ebernoe Common (Furnace Meadows) | SU976277 | 13 | 4 |
| Ebernoe Common (Meadow in Southern half) | SU972266 | 13 | 3 |
| Ebernoe Common (Unspecified) | SU9727 | 13 | 9 |
| Ebernoe Common (Northern half) | SU9727 | 13 | 1 |
| Ebernoe Village Green | SU970277 | 13 | 12 |
| Ewhurst Green Church | TQ796246 | 14 | 1 |
| Fairmile Bottom | SU935101 | 13 | 1 |
| Fishbourne Parish Church | SU839046 | 13 | 1 |
| Fittleworth Church | TQ009192 | 13 | 15 |
| Five Ashes Church | TQ558251 | 14 | 2 |
| Fosters Meadow | TQ635194 | 14 | 4 |
| Friston Church | TV550995 | 14 | 5 |
| Hadlow Down Church | TQ529242 | 14 | 13 |
| Hartfield Church | TQ479357 | 14 | 6 |
| Haywards Heath Church | TQ331219 | 14 | 14 |
| Heene Cemetery, Worthing | TQ143044 | 13 | 8 |
| Henfield Cricket Pitch | TQ225154 | 13 | 9 |
| Highbrook Church | TQ362302 | 14 | 8 |
| Horsebridge Cemetery | TQ577119 | 14 | 13 |
| Horsted Keynes Church | TQ383287 | 14 | 3 |
| Horsted Keynes Green | TQ384283 | 14 | 9 |
| Houghton Forest - unspecified | SU9911 | 13 | 1 |

| | | | |
|----------------------------|----------|----|----|
| Hurstmonceaux Castle | TQ647104 | 14 | 14 |
| Icklesham Church | TQ882164 | 14 | 2 |
| Iping Common | SU845220 | 13 | 3 |
| Isle of Thorns | TQ402276 | 14 | 19 |
| Leonardslee Woods | TQ229255 | 13 | 1 |
| Lighters Field | SU813013 | 13 | 2 |
| Little Horsted Church | TQ471183 | 14 | 4 |
| Lodsworth Church | SU931228 | 13 | 6 |
| Lower Beeding Church | TQ220274 | 13 | 11 |
| Mountfield Church | TQ734202 | 14 | 8 |
| Netherfield Church | TQ724186 | 14 | 10 |
| Newtimber Hill | TQ268127 | 13 | 3 |
| North Chailey Church | TQ390210 | 14 | 7 |
| Northiam Church | TQ830245 | 14 | 4 |
| Old Heathfield Church | TQ598202 | 14 | 16 |
| Penhurst Church | TQ694166 | 14 | 3 |
| Petworth Deer Park | SU968235 | 13 | 1 |
| Rachel Nicholson s House | TQ555239 | 14 | 5 |
| Ringmer Gliding Club | TQ485145 | 14 | 1 |
| Rotherfield Church | TQ555297 | 14 | 4 |
| Rushlake Green | TQ627184 | 14 | 9 |
| Selehurst Cemetery | TQ746243 | 14 | 3 |
| Sidlesham Church | SZ856990 | 13 | 1 |
| Slaugham Church | TQ257281 | 13 | 21 |
| South Harting Church | SU783193 | 13 | 1 |
| Spithurst Church | TQ426175 | 14 | 6 |
| St Dunstan s Farm | TQ609197 | 14 | 23 |
| St Mary s Church | TQ750158 | 14 | 4 |
| Stanmer House | TQ336097 | 14 | 1 |
| Staplefield Church | TQ278282 | 13 | 16 |
| Staplefield Green | TQ274282 | 14 | 2 |
| Stedham Church | SU864227 | 13 | 7 |
| Stopham Church | TQ027189 | 13 | 12 |
| Sullington Warren | TQ097142 | 13 | 5 |
| Thakeham Church | TQ110173 | 13 | 1 |
| The Mens (Badlands Meadow) | TQ025226 | 13 | 8 |
| The Monastery Wood | TQ345385 | 13 | 1 |
| Trotton Church | SU836224 | 13 | 5 |
| Turners Hill Churchyard | TQ337355 | 14 | 12 |
| Waldron Church | TQ549192 | 14 | 1 |
| Walstead Cemetery | TQ357246 | 13 | 21 |
| Warbleton Church | TQ609182 | 14 | 16 |
| Wartling Church | TQ657092 | 14 | 2 |
| Westmeston Church | TQ339137 | 14 | 2 |
| Willingford Farm | TQ657226 | 14 | 13 |
| Wisborough Green Church | TQ052259 | 13 | 1 |
| Withyham Church | TQ493355 | 14 | 12 |
| Wivelsfield | TQ364192 | 14 | 1 |
| Wivelsfield Church | TQ337308 | 14 | 2 |
| Woodmancote Church | TQ231150 | 13 | 3 |