High Weald AONB Unit Commissioned Report

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An overview of the character and ecological significance of gill woodland in the High Weald AONB

including results of some preliminary baseline surveys for population monitoring of selected rare vascular plants of gill woodland

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The High Weald: an outstanding medieval landscape

Our Research Programme

Futhering understanding of one of England's finest landscapes

The High Weald Area of Outstanding Natural Beauty is **one of the best surviving medieval landscapes in northern Europe**. The management objectives for the AONB are based on an understanding of the fundamental and defining character of the area – that is, the components of natural beauty that have made the High Weald recognisably distinct for at least the last 700 years and will continue to define it in the future.

- **Geology, landform, water systems and climate:** deeply incised, ridged and faulted landform of clays and sandstone. The ridges tend east-west, and from them spring numerous gill streams that form the headwaters of rivers. Wide river valleys dominate the eastern part of the AONB. The landform and water systems are subject to, and influence, a local variant of the British sub-oceanic climate.

- **Settlement:** dispersed historic settlements of farmsteads and hamlets, and late medieval villages founded on trade and non-agricultural rural industries.

- **Routeways:** ancient routeways (now roads, tracks and paths) in the form of ridge-top roads and a dense system of radiating droveways. These routeways are often narrow, deeply sunken, and edged with trees, hedges, wildflower-rich verges and boundary banks.

- **Woodland:** a great extent of ancient woods, gills, and shaws in small holdings, the value of which is inextricably linked to long-term management.

- **Field and heath:** small, irregularly shaped and productive fields often bounded by – and forming a mosaic with – hedgerows and small woodlands. These field systems are typically used for livestock grazing, small holdings, and mixed farming, within which can be found distinctive zones of heaths and inned river valleys.

The High Weald Partnership's specialist team, the AONB Unit, works to develop our understanding of these key components – their history, development, distribution, special qualities, deterioration, damage and loss – by undertaking their own research, or by commissioning independent reports. This enables us to develop an evidence base for the AONB Management Plan and other AONB policy and guidance.

Our research also informs how the High Weald landscape can contribute to society – in terms of food, energy, water provision, flood protection, recreation, biodiversity and fisheries – without damaging its natural beauty.

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Abstract

Aim To provide evidence to inform woodland management advice to landowners and woodland managers. To generate key facts and statements in support of future work to raise awareness of High Weald gill woodland and other ancient woodland habitats. To propose and pilot a programme to monitor change in the ecological character of gill woodlands through surveying selected populations of indicator species and to provide baseline data on these.

Methods A brief review of relevant geographical and botanical survey data for High Weald gill woodlands and literature related to gills was conducted to address the themes of extent and distribution, ecological character, significance and biodiversity of gill woodland habitats and the historical and cultural values associated with them. The current level and extent of protection of the known gill woodland resource is described, key threats are identified and challenges and recommendations for woodland management in semi-natural gill woodland are reviewed. Potential gill indicator and flagship species were drawn from the vascular plant floras of High Weald gills and 14 sites were surveyed to obtain detailed information on both known and hitherto unrecorded populations of selected species.

Main conclusions High Weald gills constitute an important ecological core area within the wider ancient semi-natural woodland resource of the AONB. They are of very high environmental value but relatively weakly protected by the existing framework of nature conservation designation. Effective conservation and management is further hindered both by incomplete survey of the resource - e.g. ignorance about the detailed distributions of species of nature conservation importance - and a poor understanding of the relationships between woodland management (and other human impacts) and gill woodland biodiversity. Biological survey carried out with a sufficiently long term view has the capacity to contribute to filling the knowledge gap and serve ongoing conservation efforts in gill woodlands.

Acknowledgements

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Contents

1. Introduction

The gills of the High Weald are complex and special woods which constitute a core area within the ancient semi-natural woodland resource of the AONB. Although they have been relatively little studied scientifically and their ecological communities are incompletely understood Wealden gill woods have been proposed, with ample justification, to be nationally and internationally important for their biodiversity (Rose & Patmore 1997, Burnside *et al*. 2006). They provide environmental conditions and support assemblages of species which are rarely repeated outside southeast England.

This report overviews the information available to the High Weald AONB Unit on gill woodland habitats. It draws heavily on and partially recapitulates information in the concise report on Wealden gills produced by the NCC in the 1990s (Rose & Patmore 1997) but expands on some areas in the light of AONB work, projects and experience in the intervening period as well as on a few new sources of data. The material presented makes no effort to be comprehensive and it leans towards the author's limited areas of knowledge. The report aims to give a useful compilation of information on gills in an accessible form to support the High Weald AONB Unit in the continuing development of advice and policy on ancient woodland. However, the series of unanswered ecological and historical questions set out by Rose and Patmore as needed to form a clearer conservation policy for gills remain largely unresearched.

Whilst progress in the scientific understanding gills is still strongly to be hoped for, two other perspectives emphasised in this report are on a pressing need to generate information on possible ecological change in gills in the face of changing environmental pressures on them and on the desirability of improved protection for gills. The survey work outlined at the end of this report describes very preliminary efforts towards some of the necessary botanical monitoring. It is proposed that certain ecologically indicative species may be used as focal points for survey and research on gill habitats whilst simultaneously becoming tools for raising awareness of and support for gill woodland ecology and its conservation implications.

2. Extent and distribution

Rose and Patmore (1997), working under the auspices of English Nature, reckoned there to be more than 1200 'obvious' gills in the Weald. Subsequently the boundaries of gill woods identified on maps by Dr F. Rose were digitised by Sussex Biodiversity Record Centre and later developed by East Sussex County Council so that a low-precision digital map indicating the locations of approximately 1050 gill woodland sites (many of which comprise complexes of linked linear gill features) is available for reference. Approximately 90% of the total number of sites lie within the areas of more dissected topography of the High Weald (Figure 1). As presently mapped there are approximately 9200ha of gill woodland in the AONB, i.e. roughly a quarter of all woodland. No definitive map or inventory of gill woodland exists however and there are various problems in definition of the boundaries of sites and in measuring the extent of the resource. Gill woods are often formed of intricate networks of tributary streams and linear riparian slopes graduate continuously into adjacent areas of other woodland types. Sometimes the broader slopes surrounding a linear gill feature are flushed with springs meaning that the ecological communities of the gill extend in intricate and complex mosaics into these areas. Hence, the delimitation of an individual gill site can be necessarily subjective or arbitrary. Following analysis of biological records centre data Burnside *et al*. (2006) suggest that a figure calculated in a GIS for a gill woodland area equating to 23% of all woodland within East Sussex may be an overestimate due to similar

issues. On the other hand, many small sites which conform to the character of gill woodland have not yet been formally identified as such (Sansum 2013). In spite of these uncertainties, it is clear that the High Weald AONB is the European headquarters for this type of habitat and has a special interest and responsibility for it.

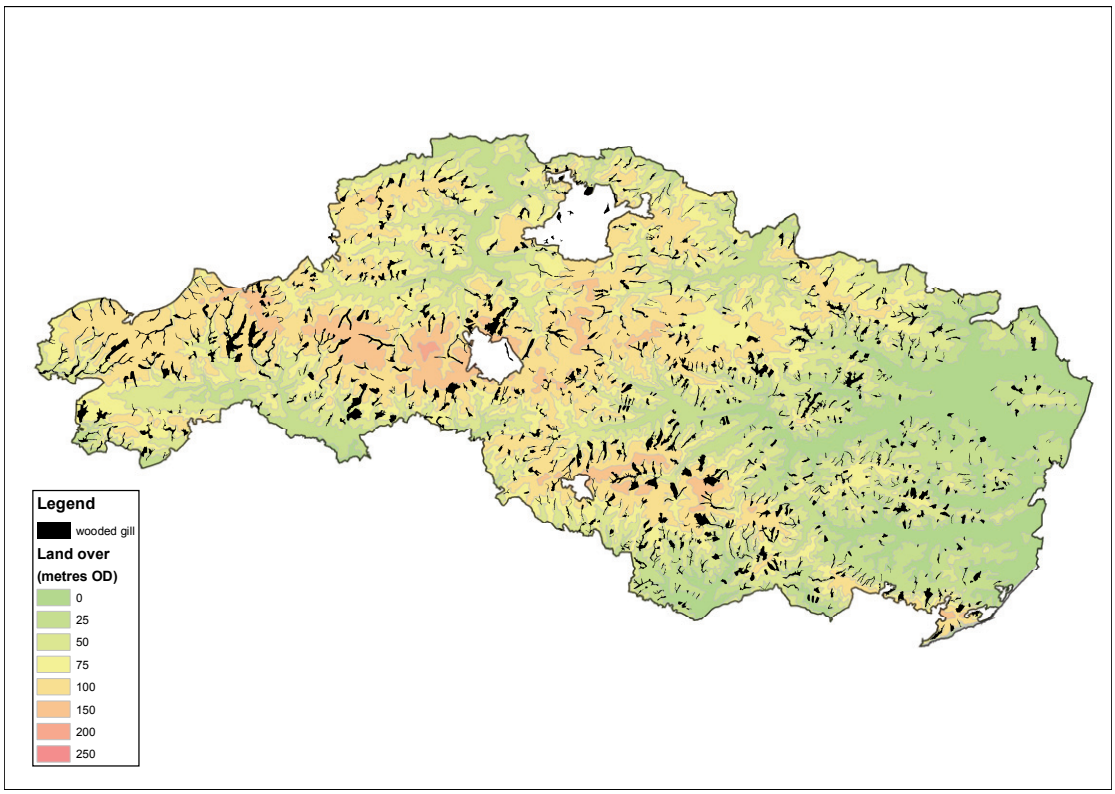

Figure 1. Map showing the distribution of know gill woodland sites in relation to the topography of the High Weald AONB. *Source: data digitised by the Sussex Biodiversity Record Centre and held by ESCC based on gill woodlands in East & West Sussex, Kent and Surrey identified by Dr F. Rose as part of a gill woodland research project carried out in 1998.*

3. Character

A 'gill woodland' is generally understood as a steep-sided valley or ravine with a particularly humid and relatively stable microclimate resulting from the combination of long continuity of shade and near constant moisture. Such woods characteristically support ancient semi-natural woodland vegetation often with high biodiversity value. In the High Weald gill systems are assumed to have been formed by the trenching of streams down through the ridged forms of the Ashdown, Tunbridge Wells Sand and Wadhurst Clay geological formations. Features such as the relatively continental climate[1], the presence of groundwater springs, the exposure of damp, soft, water holding sedimentary bedrock and relatively deep soil profiles contribute to the distinctiveness of Wealden gills as compared with gills elsewhere in Britain typically occupying upland, oceanic areas of siliceous bedrock (Rose & Patmore 1997). Efforts to come up with more precise or robust definitions are hampered by the tendency to generalise what is a complex and very variable landform and woodland type (for more detail on the scope of the term see Rose & Patmore 1997 and Burnside *et al*. 2006). The approach to the identification of Wealden gill woodland sites has

[1] Although the microclimate created in the recesses of a gill may partially replicate oceanic conditions, the general climatic regime experienced remains an important determinant of its ecology. The High Weald has a wetter climate than lower parts of south-east England but one that is still markedly more continental than that of western, upland Britain.

generally been based on expert judgement and it is clear that the sites in the existing dataset (referred to above) encompass a very broad array of types of valley selected on the basis of a range of criteria. In particular, while most gills are well wooded and steep, even precipitous, a number of streams which may be partly treeless, shallow sided or lacking in steep gradients have been identified as gills in studies by Rose and others. These generally traverse areas of relatively high, heathy, 'forest' land. Although they have an outward character quite different from a well canopied ravine wood and a distinct vegetation they have ecological affinities with other south-eastern gills.

In describing them Rose and Patmore (1997) state that gills vary enormously. An attempt to provide a more robust characterisation of the resource based on multivariate analysis of geological, soil, geomorphological and vegetational variables (Burnside *et al*. 2006) did not lead to any significant refinement in the definition of character. In this study gills (based on a random sample of 48 sites) were suggested to be reasonably uniform in terms of canopy type and geological and soil characteristics but to possess greater variability in their geomorphological, field layer and understorey characteristics. There is considerable breadth of opinion among ecologists on how narrowly the term 'gill' should be applied with some reserving it only for the sections of headwater streams with the most extreme or steeply incised topography.

Figure 2. Winter light picks out the evergreen communities of ferns and mosses which live on the steep, permanently moist banks of a spring-fed sandstone gully. Mayfield, East Sussex, January 2009.

A preliminary analysis of the distribution of known gill woodland for this report suggests that whilst the bulk of gill sites are associated with water eroded channels dissecting the sandstone ridges (Figure 2) it is important that many gill complexes contain substantial stretches traversing two or more major more bedrock types (e.g. Ashdown Formation to Wadhurst Clay Formation); more than 50% of sites extend from sandrock areas onto or into Wadhurst Clay (or vice versa) whilst an appreciable number (14%) are entirely in Wadhurst Clay areas. These gills, or parts of gills, are often less steeply incised and support a less calcifugous vegetation, such as one of the ash woodland communities (Figure 3), than the typically oak or beech and holly woodland associated with the sandstone ravines (Figure 4). Gentler topography in these gills where clay is traversed can also afford greater opportunities for the localised stands of alder woodland which develop on small flats on the floors of gills. In gills which traverse rock types therefore a mosaic of wet and dry-land woodland types (broadly speaking, alder, ash and oak or beech dominated stands) may form and the juxtaposition of plant communities does much to produce the distinctive character and diversity of gill woods. Such mosaics of woodland types also occur at a finer spatial scale for example where a gill stream cuts deeply through Tunbridge Wells Formation sandstone to expose underlying beds of Wadhurst Clay (Wooldridge and Goldring 1953) and as Rose and Patmore (1997) point out, even where a gill traverses a single rock type within the Hastings Beds, these substrates are so finely interbedded that commonly there will be strata of varying texture and base status exposed within the gill channel, so that an intricate mingling of species and communities associated with different soil and substrate conditions may be seen within very short distances. As has long been understood by naturalists (and recently formally demonstrated by Waite *et al*., 2010) the degree of underlying heterogeneity within a gill channel is likely to influence the biological richness of its associated ancient woodland just as much, if not more, than its overall size and extent.

Figure 3. Spring in part of a gill overlying Wadhurst Clay substrates. The slopes are steep yet moderate compared with those of the 'classic' gill woods in deeply cut sandstone ravines. The enriched, wet slope bases on sites like this can support herb rich ashwoods with large drifts of Wild Garlic (*Allium ursinum*) in which the Wealden speciality and national rarity Coralroot (*Cardamine bulbifera*) is also found. Salehurst, East Sussex, May 2009.

Most, if not all, gills do not have a claim to a state of absolute naturalness (see below: History and cultural value). Rather the steepness and wetness of these sites mean that in many cases historical resource use will necessarily have been less intensive than in other woods. Even on sites where greater management pressure has sporadically been applied the same topographical constraints are likely to have been more favourable for the retention of some near natural conditions or the resilience of some natural habitats and species assemblages than in woodland occupying gentler terrain.

Figure 4. An enormous slab of sandstone marks the transition of a gill stream from a moderately gentle valley over Wadhurst Clay to a plunging sandstone ravine with cascades and wet rock walls covered in ferns and mosses beneath it. Taken in mid-summer the photograph shows how features like this create permanent pools of shade, damp and green amidst the sparse June field layer of surrounding summer-dry slopes under the dappled shade of ash and hornbeam coppice. Places like this are also the confluences for quite disparate elements in the British woodland flora - in this case the strongly 'Atlantic' Hay-scented Buckler-fern, *Dryopteris aemula*, and Small-leaved Lime, *Tilia cordata*, a European-temperate lowland tree associated with primary woodland in Britain, occur quite naturally within a few metres of one another. Their localities seldom overlap elsewhere in the whole continuum of European forest vegetation. Hurst Green, East Sussex, June 2014.

It is believed that these circumstances have allowed the survival of many species of oceanic bryophytes as well as the rich vascular plant floras which characterise the vegetation of the gills (see below: Biodiversity). Rose and Patmore (1997) also suggest that the relative lack of intensive agriculture in the pastoral landscape of small ridge fields forming the catchments of many Wealden gills has helped to retain the watercourses in a fairly unpolluted condition. Summarising their character, it has been proposed that the gills of the High Weald (in reference to East Sussex) 'mark some of the oldest, least disturbed woodland in the south-east' (Marren 1992). Some gills certainly contain an impressive array of features that might be expected of natural woodland had it survived in the English lowlands. In steep, linear parts of gill woodlands where a coppice management structure is less evident a predominance of shade tolerant trees, sometimes in considerable species diversity, may be seen such as Hornbeam (*Carpinus betulus*), Field Maple (*Acer campestre*), Beech (*Fagus*

sylvatica), Wych Elm (*Ulmus glabra*), and Small-leaved Lime (*Tilia cordata*). The presence of Small-leaved Lime (Figure 8) as a wild tree in gills is noteworthy (Rose & Patmore); it is thought to have been common in the Weald 6000 years ago but is now scarce, although probably under-recorded (Sansum & Ryland 2013) and is a plant strongly associated with primary woodland (see below: Ecological Significance) in Britain (Grant *et al*. 2011). A lower tier (though often only weakly differentiated from the canopy) of bushes and small trees, also shade or semi-shade tolerant, in gills can include some or all of: Yew (*Taxus baccata*); Holly (*Ilex aquifolium*); Rowan (*Sorbus aucuparia*); Wild Service-tree (*Sorbus torminalis*); Crab Apple (*Malus sylvestris*); Midland Hawthorn (*Crataegus laevigata*); Hawthorn (*Crataegus monogyna*); Black Currant (*Ribes nigrum*); Red Currant (*Ribes rubrum*); Guelder-rose (*Viburnum opulus*). In steep gills small irregular shaped canopy gaps are common where trees have fallen downhill. This helps create a complex structured woodland with resprouting trees and dead wood bridging the ravine, sometimes supporting epiphytic plants, or lying in tangles on the valley floor (Figure 5, Figure 6). Woody debris of a wide range of sizes is often abundant in gills too (Figure 7). Features such as these are reminiscent of the hypothetical 'Present-natural' woodland imagined and expounded by George Peterken (Peterken 1996).

Figure 5. The slow decaying heartwood of a dead oak bridging the humid lower ravine of a gill is a natural niche for epiphytic mosses and ferns such as *Polypodium vulgare*. Mayfield, East Sussex, June 2014.

Figure 6. Living fallen trees such as this Holly (*Ilex aquifolium*) also create gill bridges, resprouting and layering to help produce a complex arboreal vegetation with a mixed age structure. Mayfield, East Sussex, June 2014.

Figure 7. The accumulation of coarse woody debris within gullies is one of the features which give gill woods a highly natural quality. Material like this contributes to the complex mosaic of microhabitats found in gills in numerous ways: providing habitats for deadwood species of fungi and invertebrate; niches for epiphytic ferns and bryophytes; slowing flow of water; damp mounds of semi-decomposed wood in the gill channel provide localised reservoirs of moisture which may aid in maintenance of humidity during dry periods; contributing to the mosaic of light and shade experienced on the gill floor; impeding the movement of large herbivores thereby creating heterogeneity in the levels of grazing and browsing pressure within the wood (see Linstead & Gurnell 1999, Humphrey *et al*. 2002). Benenden, Kent, June 2014.

4. Ecological significance in a national and AONB context

The significance of gill woods may be summarised in the working hypothesis that collectively they constitute an important core area of 'primary woodland' (i.e. wooded sites which have never been cleared or converted to open land though they will invariably have been managed: see Peterken 1993) within the larger semi-natural woodland resource of southeast England. There are various items of evidence for this. To quote Rose and Patmore (1997), "the floras present are remarkable, with a strong oceanic component". Some Weald gills have apparently acted as 'refugia' for oceanic woodland species of plant now absent or scarce elsewhere in lowland south eastern England. These are presumed to be relics of the mid Holocene forest vegetation. If this is correct it implies a degree of long term stability in environmental conditions in gills has allowed this long-term persistence. At the same time, Wealden gills provide habitats for various plant species of more continental or 'European-

temperate' affinity which become scarcer, or are rare or absent further north and west within Britain. Species of lower plant with strong Atlantic associations may cleave to the specific microclimate of shady rock walls deep in a gill whilst being shaded by a canopy of Hornbeam or Beech growing on the slopes above - trees requiring the more continental conditions of warm summers and cool winters of the south-east to form woodland naturally in Britain. Such locally distinctive natural assemblages of species, as well as being intrinsically valuable, are thought likely to act as indicators of a rich biodiversity (in terms of other taxonomic groups) harboured in gill woods which has yet to be revealed in detail. For example, Rose and Patmore (1997) reported early indications of an 'Atlantic' mollusc fauna to complement the oceanic elements of the flora.

Figure 8. A large multi-stemmed Small-leaved Lime (*Tilia cordata*) on the steep slope above a narrow ravine is an indication - taken along with other evidence - that this gill has direct lineal continuity with prehistoric wildwood. Hurst Green, East Sussex, June 2014.

Gills hold a special significance both to the cultural landscape patterning of the High Weald and to its nationally important resource of ancient semi-natural woodland (Brandon 2003). They represent the residue of woodland left uncleared due to 'inferior soils and difficult topography' during the period of clearance that eventually formed the 'bocage' countryside seen today (or periods - the details of the timing and duration of woodland clearance in the Weald are still being worked out). Hence they are central and distinctive features on the map signalling the cultural development of the landscape. But, as lands at or beyond the margins of cultivation, they simultaneously constitute an enduring element of wildness within that same landscape; although gills cannot be regarded as natural woodland, they possess a wealth of natural attributes absent from many lowland English woods. Elsewhere in Britain gill woodland has been judged to provide valuable examples of natural vegetation boundaries as well as relict plant species assemblages (Bunce 1989).

Gill woodlands can be regarded as core to the AONB's ancient woodland resource providing a spatial network of high quality semi-natural woodland sites which, broadly speaking, are

rather evenly distributed across the AONB designation area (every parish except the peripheral Rye and and Leigh has some gill woodland). The revised AWI has been compared with data on the distribution of gill woodland in the AONB (Sansum 2013). 26% of all ancient woodland parcels in the revised AWI overlap in part with mapped (known) gill woodlands reflecting the centrality of these, generally linear woods, to ancient woodland in the High Weald. This may be a significant underestimate of the correlation between gills and ancient woodland as there are difficulties in defining and mapping gill woodland at detailed larger map scales. The gill woodland dataset based on Francis Rose's work is, by its own description, incomplete and also includes no sites smaller than 0.5ha. If sub 0.5ha ancient woodland sites are excluded from the analysis then 33% of AWI polygons overlap with known gills. However, visual examination of the AWI dataset reveals that a large proportion of the other two thirds are in fact associated with unmapped small gills (or their tributary springs) or with other somewhat less deeply incised watercourses.

5. Biodiversity & key species

A special nature conservation importance for Wealden gills has mainly been claimed on the basis of the biogeographically significant as well as very diverse 'lower plant' assemblages found on some sites and for their vascular plant floras which can be rich in specialist forest species. The floras harbour appreciable populations of several species of generally oceanic distribution uncommon in the modern woodland of large parts of Britain (particularly the southern lowlands). The beautiful Hay-scented Buckler-fern (*Dryopteris aemula*), in Peter Brandon's words perhaps 'the most striking plant of the ghylls' (Brandon 2003), for example, although a strongly oceanic species is in fact locally more frequent in the High Weald than in other parts of its British range such as North Wales (Rich *et al*. 1996) and the Lake District.

Rose and Patmore (1997) supply a combined list of bryophytes and lichens known to occur in gill woodlands which runs to 267 species whilst in terms of vascular plants some High Weald gills are among the richest sites for ancient woodland species in southern England (Hornby & Rose 1987, Rose 1999). Deeper sections of gills maintain more humid and frost sheltered conditions than is typical in lowland broadleaved woodland and provide particularly good opportunities for a variety of British pteridophyte and bryophyte species (i.e. ferns and their allies and mosses and liverworts, respectively, or collectively, 'cryptogams'). The complex relief and microtopography coupled with often varied underlying geology provide a broad range of cryptogam habitats. Steep gill slopes, exposed rock surfaces and high shade levels create niches where competition from vigorous flowering plants may be lessened and year round surface moisture provides good conditions for the damp-dependent processes of cryptogamic reproduction and dispersal (Page 1988). Among the bryophytes which occur in High Weald gills species such as *Jungermannia pumila*, *Dumortiera hirsuta* and *Fissidens rivularis* are remarkable not just for their rarity but because their nearest colonies outside the High Weald may be 100s of kilometres away in the West Country. A readily recognisable moss that is generally rare in lowland England but is found, sometimes in abundance, in many High Weald gills - and is probably a good habitat indicator of less disturbed and potentially biodiverse sites (Rose 1992) - is *Hookeria lucens* (Figure 9).

Certain vascular plant species have been selected (Rose & Patmore 1997) as being characteristic of or associated with Wealden gill woods. Woodland Hawthorn (*Crataegus laevigata*), Opposite-leaved Golden-saxifrage (*Chrysosplenium oppositifolium*) and Large Bitter-cress (*Cardamine amara*) are species very frequent in Wealden gills but of patchy or local distribution in many other parts of Britain (Figure 11). To these, other woodland

Figure 9. *Hookeria lucens* ('Shining Hookeria', seen here with capsules) growing on the flushed gill slope near a spring of orange, iron rich water. This is the only representative found native in Britain of a largely tropical and sub-tropical family of bryophytes. Although rare in large areas of the lowlands it is present in the sheltered damp parts of many High Weald gills sometimes forming large patches. Frant, East Sussex, September 2008.

Figure 10. Tutsan (*Hypericum androsaemum*), a familiar garden plant but also a native denizen of gill woodland where it occurs frequently but usually in low numbers. As a wild plant in semi-natural vegetation it is a woodland specialist species with a western distribution in Britain and Europe. Ticehurst, East Sussex, June 2009.

specialist species, of broadly western distribution in Britain (Ratcliffe 1977, Hill *et al*. 2004) which are frequent in and characteristic of High Weald gills could be added: Soft Shield-fern (*Polystichum setiferum*), Smooth-stalked Sedge (*Carex laevigata*) and Tutsan (*Hypericum androsaemum*) (Figure 10). The last is an ancient woodland plant which seems to have significantly declined in frequency nationally (Kirby *et al*. 2005).

Figure 11. Large Bitter-cress (*Cardamine amara*), one of a suite of ancient woodland vascular plant species characteristic of the sides of gill streams in the High Weald. Frant, East Sussex, May 2008.

Key species of much more restricted occurrence for which gills are important habitats include a mixture of those with oceanic distributions and those with wider continental ranges, including some which appear to reach their north-western limit in south-east England. Oceanic elements marked out as gill associates by Rose and Patmore included Hay-scented Buckler-fern (*Dryopteris aemula*), Tunbridge Filmy-fern (*Hymenophyllum tunbrigense*) (Figure 12, Figure 13), Cornish Moneywort (*Sibthorpia europaea*), Ivy-leaved Bellflower (*Wahlenbergia hederacea*) and Round-leaved Crowfoot (*Ranunculus omiophyllus*). Alongside these they also mentioned the European temperate Coralroot (*Cardamine bulbifera*), Spiked Rampion (*Phyteuma spicatum*), Wood Fescue (*Festuca altissima*) and Small-leaved Lime (*Tilia cordata*). Royal Fern (*Osmunda regalis*) is another oceanic fern

Figure 12. Hay-scented Buckler-fern (*Dryopteris aemula*). A small colony in deep shade at the base of a steep bank in a gill through Ashdown Sands. It often inhabits surfaces where other vascular plants are sparsely represented but Hard Fern (*Blechnum spicant*) is a fairly faithful companion. Mayfield, East Sussex, June 2014.

Figure 13. Tunbridge Filmy-fern (*Hymenophyllum tunbrigense*), a strictly oceanic species which was discovered in the High Weald. Here it grows on damp, nearly vertical parts of sandstone exposures as part of a community of plants dominated by bryophytes. It demands heavy shade and in this instance tolerates the canopy of Yew trees (*Taxus baccata*) on the top of its outcrop. In the photograph can be seen some of its associate liverworts

including *Lepidozia reptans* ('Creeping Fingerwort') and *Bazzania trilobata* ('Greater Whipwort'), the latter more normally a plant of Atlantic oakwoods. Frant, East Sussex, March 2010.

worth mentioning which is rare in the High Weald but which does occur in various habitats, including on sandrocks, wet heathland gullies and bogs as well as in wet woodland.

Figure 14. Coralroot (*Cardamine bulbifera*), a nationally scarce ancient woodland plant which thrives in many gill woods in the High Weald. Its distribution is intriguing, being abundant on some sites but absent from others nearby with apparently suitable habitat (and in fact it grows on a fairly wide range of site and soil types). This has been attributed partly to limited dispersal capabilities but the natural history of its colonisation of Wealden woods is still mysterious and in the High Weald its association with gill streams may suggest some dependence on water dispersal (see Showler and Rich 1992). Salehurst, East Sussex, May 2009.

The vegetation in gill woods is dominated by various forms of W10 and W8 NVC types (*Quercus robur – Pteridium aquilinum – Rubus fruticosus* woodland and *Fraxinus excelsior – Acer campestre – Mercurialis perennis* woodland, particularly the *Anemone nemorosa* sub-communities W10b & W8b) with frequent smaller stands of wet woodland (although the floras of these alderwoods are well known, the plant communities they form do not seem to have been surveyed in much detail yet but include types of W5, W6 and, particularly, W7). Whilst the broad gill woodland vegetation conforms to expected lowland types (covered by the Lowland Oak & mixed deciduous woodland BAP in the UK), detailed surveys examining the smaller scale variability within stands reveal affinities with 'upland' communities - or at least the significant presence of stand types generally associated with more northern and western districts. Within the W10 woodland areas stands referable to the *Oxalis acetosella* sub-community (W10e) occur on damp gill slopes. In enriched areas towards the bases of slopes and on gill floors the ashwood *Allium ursinum* sub-community (W8f) is not uncommon (Oakes & Whitbread 1988, see Figure 3). The *Teucrium scorodonia* ashwood sub-community (W8g) is also reported to be present in gill woods (Patmore n.d.). There is some conservation significance to these nuances. Technically speaking, based on the equivalence of British NVC communities and European woodland types worked out by the JNCC (Hall & Kirby 1998: see Table 1), the presence of these vegetation mosaics could be used to argue

that gill woodlands provide southern English representations of '*Tilio-Acerion* ravine forests' and 'Old oak woods with *Ilex* and *Blechnum* in the British Isles'. These habitats are listed on Annex 1 of the European Habitats Directive (Council of the European Union 1992), signifying their European level importance and promoting the local implementation of robust protection measures where they occur. Conversely, most gill woodlands are currently not protected by any site level statutory conservation designation (see below: Protection).

Wet woodland occurs frequently in small patches associated with springs (Figure 15) or as narrow riparian strips sometimes expanding onto miniature alluvial flats in gill valley bottoms. Based on casual observations of these stands they often conform to an NVC W7 type community *Alnus glutinosa – Fraxinus excelsior – Lysimachia nemorum* woodland (Rodwell 1991) but sometimes the 'fit' is poor with various interesting species like *Scirpus sylvaticus*, *Galium palustre*, *Scrophularia auriculata*, *Ribes nigrum*, *Frangula alnus* or *Carex pseudocyperus* (but only rarely *C. paniculata*) represented. Some of these stands might on more detailed survey prove to be intermediate with the W5 community, *Alnus glutinosa – Carex paniculata* woodland, which is also represented in gill woods but is much less common (Oakes & Whitbread 1988).

Figure 15. Old coppiced Alder (*Alnus glutinosa*) woodland with luxuriant stands of the sedges, *Carex remota* and *Carex pendula* and *Viola palustris* and *Ranunculus repens* in a springy gill valley. The rust coloured ferruginous ooze seeping across the woodland floor comes from a chalybeate spring. The Roman iron industry in Britain was founded on the iron bearing deposits and water power of gills such as this and coppiced alderwood might have provided some of the charcoal needed as smelting fuel. Westfield, East Sussex, July 2008.

6. History and cultural value

There is a particular set of woodland archaeological features associated with gills which relate specifically to the harnessing of their potential water power - the holding back of water and the regulation of its flow - to fuel furnaces, forges and mills (Bannister 2007).

(Many gills are also rich in features associated with general former woodland management such as the processing of timber and the conversion of coppice wood to charcoal.) On those gill sites where woodland archaeological investigations have been carried out plentiful evidence of past human usage has sometimes been detected (e.g. Bannister 2009, 2014). Some of these features can appear as large and obvious earthworks (Figure 16) whilst others are very subtle and require expert and meticulous survey in order to detect against the backdrop of complex structured vegetation and the intricate small-scale natural geomorphology found in a gill valley. The research of the Wealden Iron Research Group (see Cleere & Crossley 1995) has done much to locate and describe such features but many still have not been formally recorded and do not appear on Ordnance Survey maps. Besides field archaeology, earlier estate maps showing water management systems when they were still operational would be a further source of information on the history and cultural values of gill woodlands worth investigating (Figure 17).

Figure 16. One of a number of pond bays (the raised feature running left to right in the middle) in the network of gill streams which fed Pashley Furnace – an enterprise of the Boleyn family - in Ticehurst in the 1500s. Many significant archaeological features such as this lie concealed in gill woods and have never been formally surveyed. This structure, now breached by a stream seen in the right foreground, is of monumental dimensions - over 2m high and 60m long. Photograph courtesy of Matt Pitts. Ticehurst, East Sussex, April 2010.

The emerging evidence for early human impacts and long established woodland exploitation in the High Weald has led some researchers to question the assertion of a high state of naturalness for gill woods or even to counter that gill woodlands should be understood as anthropogenic woodland systems (Harris 2003). In their perspectives however Brandon (2003) and Bannister (2007) both acknowledge that some gills may have remained essentially undisturbed for centuries or even millennia, as has been the generally received view of conservationists (e.g. Marren 1992).

It should be remembered that although phases of intense industrial exploitation in the Roman and Medieval periods (in some, not all, gills) certainly represent significant disturbances or impacts on these systems they are also relatively short-lived episodes viewed in the context of the 10 millennia of the postglacial life and ecological development of gill woods. Whilst there are strong arguments that the general woodland biodiversity of

traditionally coppiced woodland in the Weald is partly dependent on the interplay between underlying environmental conditions and long term sustainable use by people, the situation with special gill woodland biodiversity should not be perceived in the same way. Rich assemblages of Atlantic forest species have persisted in High Weald gills in spite of sporadic human disturbance not because of it and, as already mentioned, we have little detailed information about how past management impacts on High Weald gills may have changed their ecologies.

Perhaps a cultural value of gill woods just as pertinent as their association with Wealden iron making or weaving is in the tangible link to pre-industrial nature. The presence, in southeast England, of a type of landcover such as this - essentially direct lineal descendants of an Atlantic era rainforest - has a cultural importance which surely resonates beyond the biologist's or conservationist's interest to all those who live in, work in or visit the High Weald landscape.

Figure 17. Detail from an estate map of 1637 showing the extent to which some gills were formerly managed as industrial water resources. At least 19 built features including causeways, banks and pondbays cross the three arms of a gill system at Hurst Green, East Sussex creating a series of ponds and penstocks. The associated Iridge Furnace was operational just for a few decades in the 16th and 17th centuries. The impact of this episode on the ecology of the gill and how it has since responded would make a useful historical ecological study. *Source: image geo-referenced by High Weald AONB Unit for East Sussex ancient woodland inventory revision, original East Sussex Record Office: ACC 6732-2.*

7. Protection

Of 910 known gill features in the High Weald (including the Crowborough and Tunbridge Wells urban areas) only 71 are under SSSI designation (i.e. <10%). Of these, in many cases the gill woodland habitats are not the main reason for SSSI notification but represent sites which fall, or partly fall, within some larger expanse of designated land. For instance 29 of the 71 gills mentioned are sub features, often not even mapped at component level, within the extensive Ashdown Forest SSSI designation. There are no woodland NNRs in the High Weald.

As already mentioned there is strong association between gill woodland and ancient woodland and 98% of known gills within the High Weald are designated on the revised Ancient Woodland Inventory (the other sites are mostly heathland streams or exceptionally narrow linear features).

Burnside *et al*. (2006) remark on the apparent under-representation of gills in the existing nature conservation designation framework suggesting that this may stem from the often small and linear nature of the gill features within wider expanses of more ordinary woodlands that 'do not warrant designation'. Writing in the international journal, *Biodiversity and Conservation*, they conclude that Wealden gills do not receive a level of protection commensurate with their nature conservation importance. Technically, though not formally, some may rank at European priority habitat level (see pg 14, above).

A further factor underlying low rates of conservation designation may be a general paucity of evidence or information about these features, many of which lie essentially hidden in privately owned farmland. Rose (1999) listed the richest 53 sites for Ancient Woodland Vascular Plants (AWVPs: effective indicators of wider ecological interest although not necessarily correlating with bryophyte richness in all cases) in the former NCC South region plus Sussex and Kent. Six of these were sites associated with gill woodland in the High Weald, all of which are designated SSSIs.

Wealden gills tend to be more species poor than the richest lowland English woods, but they also tend to be smaller (Harding and Rose 1987; Rose 1999). Suites of small closely linked gills considered together can give high species totals for areas which are in aggregate still relatively small. As Burnside *et al*. (2006) suggest, the traditional designation process may have disfavoured such site networks by focussing on large contiguous blocks of intact semi-natural woodland whereas the nature of gills is to be patterned (and ostensibly, though not necessarily ecologically, fragmented) within intricate field mosaics. For instance, three small gills all lying within 200m of one another on the same farm and connected by linear features such a hedgerows, individually surveyed as part of the current project (see 10. below) contained a maximum of 31 AWVPs each but taken as a suite they contained 41 - within a combined area of 13ha. Theoretically this makes them compare favourably with the known SSSI designated gill woodland sites in the High Weald which have between 36 and 42 AWVP species each and range in size from 20ha to c.120ha (based on the data of Harding and Rose 1987). Another undesignated gill woodland visited (yet incompletely surveyed) in the current project generated records for 45 AWVPs making it potentially richer (and smaller at 18ha) than any of the small crop of currently SSSI designated gill woods in the High Weald AONB.

If there is the will to extend the SSSI network (Natural England 2012) to include a broader representation of this internationally important habitat then an information gap needs to be bridged. One relatively efficient avenue to identifying candidate SSSI sites - or site networks - via the AWVPs approach (Hornby and Rose 1987) would be to explore the field data

amassed by the recent AWI revisions in the AONB and elsewhere (McKernan & Goldberg 2011).

8. Threats

The general threat to gills is a lack of recognition, understanding and appropriate designation. A paucity of ecological studies of these woodlands leaves us with too little information about how susceptible or resilient they may be to various pressures. Otherwise, gills are subject to much the same set of specific threats, to greater or lesser degrees, as other areas of ancient woodland in the AONB (see e.g. Westaway 2005).

Arguably their important near-natural hydrologies coupled with their often high ratios of farmland surrounded perimeter to woodland interior area may make them particularly susceptible to eutrophication and runoff related issues. It has been suggested that even very low levels of pollution could effect significant changes in ecological communities (Patmore n.d.). The same attributes, long interfaces with adjacent land-uses and the recessed, hidden character of the woodland lying below and out of site of fields makes some sites prone to the informal dumping of various large items of farm waste (and where accessible from a public road, domestic waste). In fact, the formal use of gills as ready-made landfill sites was even proposed in the 1970s (Patmore n.d.) - an absurd plan which it is hoped will not resurface.

Conversely, steep topography and rocky or very wet areas supporting many of the more specialised species assemblages within gills may afford these ecologies some natural protection from deer herbivory which elsewhere is degrading many areas of semi-natural woodland in the AONB. Where livestock are pastured in woods these areas may also be relatively inaccessible to them. Simultaneously, trampling of bracken and browsing of bramble, ivy and honeysuckle etc and heavily shading understorey shrubs like holly on the gentler slopes and banks encircling such microsites can potentially help maintain them free of excessive ground level shade and competition (Mitchell and Kirby 1990). Similarly, many gills contain higher levels of coarse woody debris and complex non-vertical tree and shrub growth than adjacent coppice woodland, and this is clearly in some cases sufficient to impede the movement of large herbivores into sensitive areas (Figure 7).

Coniferous plantations, especially neglected un-thinned ones, on and around the slopes of gills are a clear threat to the general ecological health of their ancient woodland habitats (Chapman 2008). However, beyond the general threat of increasing shade, acidification etc from the planted crop a secondary threat exists in the form of the invasive potential of the crop species used. Shade bearing trees originating in the Pacific Northwest like Western Hemlock (*Tsuga heterophylla*) are well adapted to gill-like conditions and can regenerate naturally in gills on clayey substrates. On PAWS sites in these situations, particularly where the crop was originally planted close to the edge of the stream, new generations of introduced conifers can spread into the last ribbon of unplanted riparian habitat (already compromised by shade from the maturing planted trees). Both Sitka Spruce (*Picea sitchensis*) and Western Hemlock have been observed seriously encroaching onto the vestigial strip of ASNW in replanted gills in the AONB. In these situations the trees will of course have maximal impact and be especially difficult to extract once established.

There are a number of introduced species either posing actual or potential threats to gill vegetation. Well known is *Rhododendron ponticum* which can spread along gill banks severely darkening the subtle pattern of light and shade in valley bottoms to the near exclusion of semi-natural vegetation. Along with *Prunus laurocerasus* (Cherry Laurel) its

spread has been cited as a severe problem in many gill woods (Rose & Patmore 1997) particularly in the Weald forest ridge area (Rich *et al*. 1996, Brandon 2003, Westaway 2005). Two introduced species (natives of wet North American forests) which have the potential to behave invasively recorded in the current survey (10. below), either in gills or along water courses closely connected with gill woodlands, were *Tolmiea menziesii* (Pick-a-back-plant) and *Lysichiton americanus* (American Skunk Cabbage). The former has not yet been widely recorded in the Weald but, judging from its performance in some localities in north and west Britain is capable of becoming a nuisance and successfully invading high quality semi-natural ravine woods and, by its rapid vegetative spread, outcompeting specialist native species for suitable microsites by covering the ground. American Skunk Cabbage appears to have become established in the 1970s in its Wealden sites and is probably spreading. This is a plant which can move into alderwoods in swampy areas of gills and displace a range of native species (Figure 18).

Regarding the possible effects of climate change on gill ecology there are reasons to expect change (or that it is already occurring) but little evidence for it due to lack of long term data series (either on the underlying abiotic variables or on the dependent biodiversity). Basic monitoring and observations of some key species could help supply much needed information. Oceanic species which thrive on low yearly temperature ranges, stable moisture regimes and relatively cool summer temperatures might not be expected to flourish under forecast scenarios of hotter drier summers for the South-east. Some gill valleys run almost dry in summer and it is not clear how great their capacity to provide a microclimate buffered from the conditions experienced on the plateaux is. If oceanic species in Britain are adversely affected by climate change then it is their most south-easterly populations, in the High Weald, which might be the first to respond. As Patmore (n.d.) notes, the impact of abstraction and impoundment of water within gill stream catchments on the microclimatic conditions of the gill has yet to quantified. In considering possibly new forcing effects from climate change on gill microclimates the potential interaction with unknown quantities which may already be exerting an effect needs to be considered.

Figure 18. The very large leaves and rhizomatous growth of American Skunk Cabbage (*Lysichiton americanus*) - a giant relative of the native Lords-and-Ladies (*Arum maculatum*) - make it a potentially devastating competitor to a wide range of small native plant species of gill alder stands. In this case Remote Sedge (*Carex remota*), Large Bitter-cress (*Cardamine amara*), Opposite-leaved Golden-saxifrage (*Chrysosplenium oppositifolium*) and Wood Speedwell (*Veronica montana*) amongst others were apparently at direct risk. Wadhurst, East Sussex, June 2014.

9. Recommendations for gill management

At this stage, it is not at all clear how gill woods should be managed for nature conservation. It will be essential to examine this aspect soon if their potentially high nature conservation interest is not to be lost due to neglect. (English Nature, High Weald Natural Area profile)

The historical management and disturbance regimes of High Weald gills have not yet been investigated in detail. Most will have come under coppice management but there is a suggestion that gills or the parts of them with particularly steep sides may have been left alone as 'not worth the effort' (Rose & Patmore 1997).

As a result of this uncertainty over how intensively gill woods have been managed we have little information on what level of disturbance the current biological heritage of these sites has been able to withstand, or to what extent historical management may have influenced them. Oceanic woodland species of lower plant are, like all green plants, not dependent on darkness but on light and in fact, like many woodland species, may often benefit from moderately increased light levels. The correlation of their habitats with shade is probably as much connected with the maintenance of humidity and reduction of competition from other less shade tolerant species of flowering plants (and possibly frost amelioration) than a requirement for low light levels. However, whilst in some regions of the British Isles these assemblages have been suggested to be far more resilient to canopy level disturbance than once assumed (e.g. Ratcliffe 1968, Edwards 1986) in the Weald there is still room for special caution in this regard. Wealden gills experience a more continental climate than their counterparts in western ravine woods (Rose & Patmore 1997) and many of the high nature

conservation value plant species found in Wealden gills, vascular and non vascular, are at the limits of their distributions in Europe. It is reasonable to suppose therefore that their sensitivity to disturbance in the Weald, especially now that a period of warming summers apparently has been entered, might be higher than in other parts of their ranges. In summary, since many of the species for which gills are particularly important are desiccation sensitive or humidity demanding organisms, the precautionary approach of avoiding drastic alterations to the light environment experienced by the ground flora in gills seems appropriate as a general rule.

Non-intervention has been proposed as the default management advice for gill woods (Rose & Patmore 1997) pending further information on the relationships between the particular biodiversity of Wealden gills and woodland management. Guidelines on how far such non intervention should extend away from a gill stream into adjacent woodland have not emerged and would be difficult to prescribe due to the great variability of gill size and form. Especially for sites with valuable epiphyte communities, the maintenance of moderate grazing levels to prevent the development of dense shading undergrowth was also recommended.

A particular issue for gill woodland management is the potential impact of the restoration of PAWS (Replanted Ancient Woodland) which often occurs on the plantable land on the shoulders and slopes immediately adjacent to the riparian gill habitat. Considerable attention has been given to watercourses running through areas of PAWS as retained semi-natural woodland features which can provide focal points from which the restoration of semi-natural conditions can expand outwards. Contrary to the notion of non intervention in gill woodland therefore, such areas of linear ancient semi-natural woodland may actually become targets for thinning in PAWS restoration plans in order to increase light levels, bolster populations of ancient woodland vascular plants and boost colonisation potential in restored areas (Thompson *et al*. 2003, Woodland Trust 2005). Consequently, in some scenarios it will be important to guard against the possibility of favouring conspicuous elements of the ancient woodland plant assemblage, such as the common vernal flowering herbs associated with coppice woodland, over more specialist but less conspicuous plants of restricted habitat range.

Although advocating a default position of non-intervention Rose and Patmore (1997) also suggested that in neglected coppice areas in gills which were particularly dark but known to be biologically rich, management might profitably be resumed.

These nuances make a one-size-fits-all management prescription for gill woods impossible. Effective conservation and protection of valuable features in gills where there is active woodland management may depend to a large extent on improving awareness among owners, managers, contractors and workers of special and/or potentially sensitive features within the system so that they can be called to the attention of management planners in a timely fashion[2]. For example, small fern or bryophyte rich banks, especially where steeper than 45°, should be treated circumspectly. These are ancient woodland features which in some cases may have great antiquity, take centuries to develop and may not recover if damaged by mechanical harvesting gear. Rates of change should be minimised in the immediate vicinity of these areas and extraction routes should avoid them. Where these options are impractical surveys ought to be undertaken in order to check for the presence of scarcer species. Populations of special plants such as the slow-growing Hay-scented Buckler-fern (*Dryopteris aemula*) often occur as scattered individuals or small groups mixed within

[2] This important role for raising awareness of special and/or sensitive biodiversity features in the gill woodland resource - which is largely under private ownership and management - is rightly promoted in the Local Biodiversity Plans of some local authorities (Tunbridge Wells Borough Council 2008).

stands of superficially similar but common species such as Broad Buckler-fern (*Dryopteris dilatata*) and can therefore be easily and inadvertently destroyed (Rich *et al*., 1996, refer to the loss of a colony dislodged by 'small boys sliding down the bank'.). The inconspicuousness of rare bryophytes is similarly to be considered.

Clearly determining where thinning, or recoppicing, is acceptable or even desirable within a gill depends on a site based assessment of the topography and potential for damage to riparian habitat and/or other gill woodland features, such as rock outcrops, steep banks supporting fern and bryophyte assemblages and swampy streamside flats supporting wet woodland communities. Such an assessment then has to be weighed against the perceived ecological threat of not undertaking the work.

If activities that would alter light levels and disturb soils or substrates within 20 metres of the stream edge are necessary - e.g. in order to release native riparian trees from conifers planted to the edge of the gill - they should be carefully considered and monitored closely. Brash should be stacked away from semi-natural vegetation in the immediate corridor of the gill stream and some riparian trees or shrubs, i.e. shading the gill stream itself, should be retained so that no long sections of gill bank are suddenly totally denuded of shade.

Gill woods represent unique combinations of semi-natural woodland features but for management purposes - because of the soil and vegetation sensitivity and year-round wet conditions - many of the principles applied to wet woodlands, minimising rates of change, maintaining mature habitat and extraction with extreme care and sensitivity to avoid ground damage etc are to be followed (e.g. FC 1994). Pending further information on the management-biodiversity relationship of Wealden gills a review of the management advice elsewhere, including for example the European and North American ecological restoration literature, in place for analogous steeply incised wooded headwaters might provide useful insights.

10. Description and results of a survey of selected rare vascular plant species of gill woodland

10.1. Aim

To assess the status of sampled known populations of selected plant species associated with gill woodland in the High Weald AONB and to collect and present information on their habitat and vegetation context that will be relevant to future development in understanding of gill ecology and informing management.

10.2. Rationale

There is a shortage of recent detailed data on the occurrence of special plant species associated with gill woodland in south-east England - a habitat for which the AONB has special responsibility and whose ecology generally is poorly studied. Many existing species data have poor spatial resolution and take the form simply of presence/absence records. They often lack any account of population size, condition or habitat. This makes monitoring change in these valuable features of the AONB's woods difficult. Better information - even from a small sample of sites - has the potential to provide meaningful support for woodland managers and nature conservationists wishing to predict habitat suitability for species level action or assess the appropriateness of different management options in gills.

Recent improvements in handheld GPS technology enable very detailed records of plant locations and populations to be made. Only with ongoing investment in proactive investigative field survey work can this be exploited and the project is an example of such.

In addition to data on target species, the collection of data on their companion species - the vegetation context - from sample sites has the potential to contribute to understanding the ecology of gills in the wider context of British and European woods.

Existing vegetation data on gills mostly dates from the pre-digital period and is not generally available. The data generated by this project has been digitised and made freely available to interested parties. The data generated may be of some value in augmenting the revised AWI as an evidence source supporting the extension of SSSI designation (as has been pledged by government).

10.3. Methods

1. A list of species as potential targets for survey and monitoring was constructed based on a selection of vascular plants restricted to gill woodland in SE England or characteristically associated with it. Additionally some species of rare or scarce plants which are not strictly woodland species but whose habitats are closely associated with the occurrence of gill woodland in the High Weald were included (certain species of riparian and heathland habitats and of damp disturbed places within ancient woodland).

Cardamine amara	Large Bitter-cress
Cardamine bulbifera	Coralroot
Carex laevigata	Smooth-stalked Sedge
Centunculus minimus	Chaffweed
Dryopteris aemula	Hay-scented Buckler-fern
Equisetum sylvaticum	Wood Horsetail
Festuca altissima	Wood Fescue
Gnaphalium sylvaticum	Heath Cudweed

Hymenophyllum tunbrigense	Tunbridge Filmy-fern
Lobelia urens	Heath Lobelia
Osmunda regalis	Royal Fern
Phyteuma spicatum	Spiked Rampion
Radiola linoides	Allseed
Ranunculus omiophyllus	Round-leaved Crowfoot
Sibthorpia europaea	Cornish Moneywort
Tilia cordata	Small-leaved Lime
Trichomanes speciosum (gametophyte)	Killarney Fern
Wahlenbergia hederacea	Ivy-leaved Bellflower

Plants on the list generally qualify as rare or scarce at county, regional or national level but some other species were included which are of particular ecological significance when occurring in gill woodland vegetation (e.g. *Tilia cordata*) or that, although locally frequent in the High Weald, are scarce or absent in many other parts of lowland England (e.g. *Cardamine bulbifera* and *Carex laevigata*). Some of the plants on the list are extremely rare in the High Weald and possibly extinct whilst others are locally quite common. Sources used in drawing up the list included the Rare Plant Registers for Kent and Sussex, the BSBI distribution database and previous publications and reports on gill woodland and SSSI notifications. The list is not definitive and can be edited and added to but provides a range of species for which detailed survey and monitoring in the AONB would be worthwhile[3], both in assessing the condition and status of their populations and in informing future woodland management.

2. Thirteen known gill sites were visited during a 10 day survey contract in June 2014 (additionally two other sites were visited in order to record known *Osmunda regalis* colonies). Survey site selection was informed by the distribution of old records of target plants and by site access considerations. Due to the short duration of the project - and because it can be seen as a pilot for possible further work - publicly accessible sites were prioritised to avoid undue expenditure of time on obtaining permission to access sites. In terms of collecting baseline information for monitoring populations, these sites also have the advantage of being likely to be reasonably easy to arrange repeat recording visits.

In the current survey recording effort focussed on *Dryopteris aemula* which, following the research of Francis Rose on the fern, may be proposed as a 'flagship species' for High Weald gill woodland and to a lesser extent on *Tilia cordata* which occurred in one of the same gills visited as *D. aemula*. Data were also collected from a single known site for *Equisetum sylvaticum* in Kent on the basis that detail on its habitat could inform future searches for the plant in East Sussex where it was formerly found in the High Weald but has not been recorded recently (Briggs 2001).

Surveys consisted of searches of suitable habitats within each gill, mainly confined to the woodland within c.50m of the base of the gill channel. Data on the whole vascular plant flora encountered during the course of these searches was collected at 1km square resolution. If target species were located quantitative data on populations of plants were collected along with precise location details made using a handheld GPS (Garmin GPSmap 60CSx) and the British National Grid. Where practicable, information on the vegetation context of each of the populations was collected by assessing abundance (on the Domin scale) of species present within the immediate vicinity of the plants. This approach was based on modified NVC woodland survey methodology (see Kirby 2011) whereby a homogeneous stand is recorded within a 5m x 5m plot (or smaller if the vegetation is constrained at a finer spatial

[3] Some of these species have already been surveyed and researched in some detail, e.g. Showler and Rich (1993).

scale than this) including an assessment of trees and shrubs within a wider 15m radius. In practice *Dryopteris aemula* tends to occur on microsites atypical of the surrounding woodland making the assessment of homogeneous vegetation stands sometimes unrealistic. In these circumstances the recording of companion species and estimates of their abundance was based on attempting to relate the extent of each colony or group of target plants to a topographical feature exhibiting reasonably uniform vegetation and take that as the stand. This resulted in some samples too small to reliably diagnose NVC type, particularly to sub-community level. Nevertheless the data on companion species will potentially be useful in determining habitat preferences and the abundance data will allow broad scale vegetation change (i.e. change in the target species' growing conditions) to be assessed in future monitoring visits (as well as change in population of target species). For future monitoring visits it is recommended that this be supplemented where feasible with photographs showing as much as possible of each stand and tagged with the sub-site codes used in Table 1 (with unique codes of a similar format generated for other sites and species)

10.4. Results

The full data arising from all the survey work undertaken in 2014 are included in the appended data file. The rest of this report summarises the results of the rare plants recording.

The Site-species summary table below (Table 1) provides a key to the individuals and populations recorded. The site codes should be used in conjunction with the full field data in the appendix to this report. The data appendix contains precise location information (in comments field of 'General records' worksheet) which will enable sites to be refound in the field for monitoring in the future. Those sites for which detailed data on companion species and vegetation context are available are also included as separate worksheets within the data appendix (the numbers following each species entry represent values on the Domin scale).

Populations of *Dryopteris aemula* were located in five of the gills visited (on Ashdown or Tunbridge Wells sands). In total 267 plants were recorded either as scattered individuals or in groups of up to about 30 plants (though some of these groups were sometimes in close proximity to one another). Sizeable colonies were recorded from Robin's Wood and Nap Wood where previously there was little information available on the strength of these populations and in the former case data on the plant's location within this large gill complex were imprecise, although it has been recorded there since 1955 (see Kitchener 2014). A population at Parsonage Wood was reported to be 'abundant' by Francis Rose in the 1950s (Kitchener 2014). In the present survey 5 rather small groups of plants in close proximity to one another were seen at that site. As far as records show, one of the sites, with a small population of 16 plants is a previously unrecorded locality for the species (Rolf's Farm). Previous information indicated a group of 7 plants in Burgh/Bellhurst Wood but the results of the current survey suggest that the colony is more extensive with at least 17 plants recorded, mostly in scattered small groups or as individuals downstream of the previously recorded 7 plants. This gill is extensive with many apparently suitable sites and it is possible that further searches could find further plants. *Tilia cordata* was found to have an extensive but low density presence within this wood and it is almost certain that the 18 trees located in the course of the *Dryopteris aemula* search represent only part of the population.

Site_Species Code	Site name	Locality	Species		Number of plants	Altitude	NVC type	Description
RW_DA001	Robin's Wood	TQ7634	*Dryopteris aemula*	Hay-scented Buckler-fern	30	80m	W10a	17 plants on steep (>60° slope) mossy N-facing bank 3m high (+ 13 outlying plants scattered in the immediate vicinity). Associated with gill-holloway junction.
RW_DA002	Robin's Wood	TQ7634	*Dryopteris aemula*	Hay-scented Buckler-fern	9	75m	W10	9 plants on steep gill bank c.5m high, N-facing, under Quercus petraea & Ilex aquifolium. Bank v mossy with Mnium hornum, Plagiothecium undulatum & Blechnum.
RW_DA003	Robin's Wood	TQ7634	*Dryopteris aemula*	Hay-scented Buckler-fern	18	75m	W10	18 plants. Steep 4m high bank descending to edge of gill stream. Plants within 3m of water in shade of Ilex aquifolium.
RW_DA004	Robin's Wood	TQ7634	*Dryopteris aemula*	Hay-scented Buckler-fern	26	75m	W10	20 plants, N-facing sandrock bank of gill (+ 6 plants on opposite S-facing bank). Wood recently cut to edge of bank under pylons leaving plants near top in sun.
RW_DA005	Robin's Wood	TQ7634	*Dryopteris aemula*	Hay-scented Buckler-fern	25	75m	W10	25 plants mixed with D. dilatata on steep NE-facing bank under Castanea sativa . Ground cover of Mnium hornum. Contiguous with DA004 but not in wayleave strip.
RW_DA006	Robin's Wood	TQ7634	*Dryopteris aemula*	Hay-scented Buckler-fern	17	75m	W10	17 plants in similar situation to RW_DA005
BW_DA001	Burgh/Belhurst Wood	TQ7227	*Dryopteris aemula*	Hay-scented Buckler-fern	3	40m	W10e	3 plants, E side of gill, base of large hollow Fraxinus excelsior
BW_DA002	Burgh/Belhurst Wood	TQ7228	*Dryopteris aemula*	Hay-scented Buckler-fern	7	45m	W10	(refound from 2008 BSBI record by A. Knapp): 7 plants, bottom half of steep (c.60° slope) NW-facing, 3m-high bank nr sandstone ledge/waterfall.
BW_DA002a	Burgh/Belhurst Wood	TQ7228	*Dryopteris aemula*	Hay-scented Buckler-fern	4	40m	not recorded/undiagnosed	1 large vigorous plant in gill bottom (plus at least 3 more much higher on the E gill bank approximately above this plant can be seen with binoculars)
BW_DA002b	Burgh/Belhurst Wood	TQ7228	*Dryopteris aemula*	Hay-scented Buckler-fern	3	45m	W10	Additional 3 small plants a short distance away from 7 recorded 10/06/2014 (BW_DA002) to NW on top of same bank towards rock ledges.
NW_DA001	Nap Wood	TQ5932	*Dryopteris aemula*	Hay-scented Buckler-fern	14	115m	W15b	14 plants, S-facing bank of holloway but formidable shade from Castanea, Quercus robur, Ilex & Fagus
NW_DA002	Nap Wood	TQ5932	*Dryopteris aemula*	Hay-scented Buckler-fern	32	115m	W15	25 plants on N-facing bank of holloway plus 7 outlying in immediate vicinity, scattered under Castanea shade above bank
NW_DA003	Nap Wood	TQ5832	*Dryopteris aemula*	Hay-scented Buckler-fern	32	120m	W10	32 plants on banks of holloway (mostly but not exclusively on N-facing bank)
NW_DA004	Nap Wood	TQ5932	*Dryopteris aemula*	Hay-scented Buckler-fern	2	110m	W7b/W10 transition	2 plants at base of Alnus (5 plants at same spot recorded 11/10/2009), edge of flush on SE-facing slope
PW_DA001	Parsonage Wood	TQ7932	*Dryopteris aemula*	Hay-scented Buckler-fern	13	65m	W15	13 plants in deep shade on NW-facing gill bank under Fagus and Ilex, with sparse Blechnum and D. dilatata
PW_DA002	Parsonage Wood	TQ7932	*Dryopteris aemula*	Hay-scented Buckler-fern	3	65m	W10	3 plants in a lush mixed stand of ferns with D. dilatata, D.affinis, Blechnum spicant & Athyrium filix-femina
PW_DA003	Parsonage Wood	TQ7932	*Dryopteris aemula*	Hay-scented Buckler-fern	7	70m	W7/W10	7 plants in narrow defile of gill sidearm (4 on steep banks, 3 at base of small cascade/dripping ledge) with 50cm patch Hookeria lucens directly beneath
PW_DA004	Parsonage Wood	TQ7932	*Dryopteris aemula*	Hay-scented Buckler-fern	1	60m	not recorded/undiagnosed	1 large plant on damp E-facing rock exposure, covered in thalloid liverworts, close to gill stream
PW_DA005	Parsonage Wood	TQ7932	*Dryopteris aemula*	Hay-scented Buckler-fern	5	55m	not recorded/undiagnosed	5 plants, base of N-facing bank in heavy shade of large Fraxinus
RF_DA001	Sandall's Ghyll	TQ6227	*Dryopteris aemula*	Hay-scented Buckler-fern	12	65m	W10e	12 plants spaced out on lower half of a steep NW-facing gill bank.
RF_DA002	Sandall's Ghyll	TQ6227	*Dryopteris aemula*	Hay-scented Buckler-fern	3	65m	W7/W10 transition	3 small plants on W-facing slope in untypically dense vegetation of other vascular plants.
RF_DA003	Sandall's Ghyll	TQ6227	*Dryopteris aemula*	Hay-scented Buckler-fern	1	70m	not recorded/undiagnosed	1 small plant next to gill stream a few m below clearspan bridge.
BW_TC001	Burgh/Belhurst Wood	TQ7227	*Tilia cordata*	Small-leaved Lime	5	35m	W8f/W10 transition	5 trees next to gill stream, all 2 or more stemmed, un-even aged, up to 94cm dbh, layering stem bridges gill. Possibly all same individual?
BW_TC002	Burgh/Belhurst Wood	TQ7228	*Tilia cordata*	Small-leaved Lime	10	55m	W8a	10 or more large multi-stemmed trees on E facing slope above gill
BW_TC003	Burgh/Belhurst Wood	TQ7228	*Tilia cordata*	Small-leaved Lime	1	45m	W8a	1 large multi-stemmed tree on side of gully with dead stumps within 10m, stems, not even-aged, up to 120cm gbh. 1 fallen pole initiating layers along gully.
BW_TC004	Burgh/Belhurst Wood	TQ7228	*Tilia cordata*	Small-leaved Lime	1	45m	W8f	single stemmed tree, gbh 73cm
BW_TC005	Burgh/Belhurst Wood	TQ7228	*Tilia cordata*	Small-leaved Lime	1	50m	W8f	large multi-stemmed tree 1m away from gill stream, stems, not even-aged, up to 105cm gbh.

Table 1. Summary of data collected on target species in June 2014.

10.5. Discussion - Hay-scented Buckler-fern - a potential indicator and flagship species

Hay-scented Buckler-fern (*Dryopteris aemula*) is a drought sensitive, acid loving fern with a highly restricted distribution in Europe. In much of England away from the Atlantic seaboard it is a rare woodland plant and in the south-east strongly indicative of a characteristic Wealden gill ecology. Its presence as a constituent of the vegetation of gills in the High Weald of Kent and Sussex has been noted since the 19th century but the details of its distribution and their ecological and biogeographical significance were only later revealed by Francis Rose's research (1958). Although locally frequent in the High Weald it is a species with important conservation implications nationally because Britain and Ireland hold most of the world population (Page 1997, Cheffings & Farrell 2005). With its relatively specialised habitat requirements and close correlation with species-rich High Weald gills and its intrinsic beauty and appeal it has value potentially both as an ecological indicator species and as 'flagship' for the conservation and understanding of Wealden gills. In some of its sites it is known to have declined drastically since the 19th century (e.g. Eridge Rocks) but owing to a lack of detailed information on many of its colonies beyond their general whereabouts we have little knowledge about population trends. In the face of warming summers and potential resumption of coppicing (an activity which is not expected to favour this species) in some long unmanaged gills, this represents a key knowledge gap.

Figure 19. The bright green arching fronds of Hay-scented Buckler-fern (*Dryopteris aemula*) stand out vividly in the gloom on the holly lined bank of a holloway through gill woodland. Frant, East Sussex, September 2008.

10.5.1. Brief characterisation of the Dryopteris aemula *habitats observed on the survey sites*

Most of the colonies were on steep (>45°) banks and within 10 to 20m of the gill stream. Notably, on two of the sites plants utilised banks associated with holloways over Tunbridge Wells sands leading into the bottom of gill valleys (Figure 19). The typical bank site faces northwest, north or northeast but where there are strong colonies on these there can sometimes be found a few plants in shade on nearby southern aspects. In deeply incised gills where plants grow amongst rocks very close to the stream aspect seems less critical. Sometimes plants grow out of notches on the bank formed by the surface roots of the shading tree (this habit was recorded with *Fagus* and *Fraxinus*).

The most frequent associates of *Dryopteris aemula* recorded were the ferns *Dryopteris dilatata* and *Blechnum spicant*, followed by *Ilex aquifolium* and the bryophyte *Mnium hornum*. Bryophytes were not systematically identified in the survey but the conspicuous absence of the thick mats of large, slow growing pleurocarpous mosses which characterise the habitats of *Dryopteris aemula* in west Britain was noted and many sites had appreciable areas of un-vegetated soil or rock on them (although bryophyte communities could be well developed on nearby microsites) including deer-trampled areas. Nevertheless the presence of *Hookeria lucens* with five of the groups of *Dryopteris aemula* surveyed and *Plagiothecium undulatum* with three is significant; these have been considered 'ancient woodland bryophytes' in lowland England and the occurrence of the former believed indicative of a less disturbed woodland history (Rose 1992). Most sites were heavily shaded, often by *Ilex aquifolium* (Holly) growing under the crown of mature *Quercus* or *Fagus*. *Castanea sativa* or *Carpinus betulus* was often present but its recording more reflects the composition of coppice woodland immediately adjacent to the fern's habitat than intimate association. Similarly *Rubus fruticosus* was often present but usually only as stray scrambling stems originating in adjacent W10 stands. Cover of herbaceous flowering plants was usually sparse in the spots where the fern grew but *Luzula pilosa* and *Oxalis acetosella* were frequently present in small amounts. These companion species are broadly similar to those reported by Rose (1958) except that *Vaccinium myrtillus* and *Luzula sylvatica* were given rather than *Luzula pilosa* and *Oxalis acetosella* as the more frequent flowering plant associates. Notably, whilst often in very close proximity to bushes or small trees of Holly the fern avoids the very darkest areas under the centres of their crowns. It is a possibility that Holly's wintergreen foliage is providing a degree of cold protection for some colonies. Frost sensitivity is suggested as a key factor limiting the range of the species in Britain (Page 1988) but the plants at Nap Wood occur at well over 100m altitude whereas according to Page (1997) most of its habitats in Britain lie below the 30m contour (in fact most High Weald colonies are probably above 30m as few sandstone gills extend much below this height). Other notable companion species were *Oreopteris limbosperma* which is local in the Weald outside Ashdown Forest.

10.5.2. Evidence for colonising behaviour

At two sites (Nap Wood and Robin's Wood) field observations may suggest expansion of the colonies. Scattered small plants were found in areas adjacent to the apparently more well established stands of larger plants. In both cases the scatter of plants appears to have expanded from its centre on an 'optimal' north facing bank into outgrown *Castanea sativa* coppice above the top of the bank (at Robin's Wood possibly aided by the presence of a damp runnel extending into this area). In these situations it may be able to exploit the lack of competition from other herbs due to heavy shade. It seems unlikely that these relatively weak groups of plants represent persistence in such areas through former coppicing cycles

(though it cannot be ruled out) or indeed that they would withstand re-coppicing of the *Castanea* now. These groups of plants are interesting as possible examples of recent dynamism in a species which may have became confined within narrow refugia during the historical period of intensive coppice management in the Weald. At Nap Wood the expansion appears to have proceeded further with a few plants (notably vigorous ones with fronds up to 85cm long) found at the transition of W10 woodland on a ridge to flush W7 woodland on a southeast-facing gill slope. Here the plants grow around the base of an *Alnus glutinosa* tree apparently benefiting from the dampness or humidity of the flush woodland but also protected from waterlogging by the slightly raised microtopography of the tree base. The slope is also part of a formerly coppiced stand and the plants are presumed to be relatively recent colonists originating from the strong bank population 30 metres away. This microhabitat - tree bases in alder woodland - is not typical (the species being generally associated with acid well drained banks in humid and shady, often north-facing, situations or with mossy boulders or rock faces in uncoppiced slope woodland) but it is possible that this was a niche occupied by the species in the unmanaged woodlands of the past. Similarly vigorous groups of plants can be found on the bases of mature *Alnus glutinosa* in W7 woodland at Horner Wood in Devon where there are strong bank-side colonies of the fern in reasonably close proximity (personal observation) - a possibly analogous situation at a later stage of development. In the New Forest there are reports based on Francis Rose's observations (cited as personal communication by Rich *et al*. 1996) of *Dryopteris aemula* colonising relatively recent drainage ditches but the precise circumstances are not known. Further observations are needed to corroborate whether some populations are expanding in unmanaged Wealden gills and whether the pioneered areas can be sustained. The information arising would be useful to inform decisions on woodland management on *Dryopteris aemula* sites or on their conservation.

10.5.3. The need and potential for monitoring

Although 4 of the 5 sites where *Dryopteris aemula* was recorded were known stations there is generally very little basis for making any concrete assessment of change based on the most recent records reported here. At Burgh/Bellhurst Wood 7 plants precisely recorded by the BSBI vice-county recorder in 2008 could easily by refound using a GPS - indicating no change since 2008 (BW_DA002). At Nap Wood, based on a spatially precise BSBI record, one of the small groups of plants (NW_DA004) can be said to have declined from five individuals to two since 2009, but the larger groups present unfortunately were not accurately counted by the recorder at that date (although estimates given suggest less drastic change).

On the sites surveyed *Dryopteris aemula* tended to be distributed as several scattered groups of plants and this is said to be typical of its occurrence in High Weald gills (Rich *et al*. 1996). Owing to the spatial uncertainty associated with pre-digital era recording of the plant it is generally not possible to be sure which groups of plants have previously been recorded or to be clear if stands are static (the general assumption for a relic species with restricted distribution) or if there is mobility of the species within, or even between, the woods where it occurs (see above).

These remarks underline how valuable accurately recorded counts and locations of (even just a small number of) colonies (such as those supplied with this report) could potentially be for future efforts to gauge the effects of climate change, woodland management change and, importantly, to chart unforced natural population fluctuations. Some knowledge of

population trends is a vital criterion for assessing a species' conservation status. The records summarised above and appended provide a baseline on which to build a dataset.

The information has been collected at a level of precision that should allow the same groups of plants to be relocated with ease in the field and with a degree of certainty that the same populations are being observed. Most of the sites are located in areas where access ought to be readily allowed. The data are generally more spatially precise and provide more detail on population size and associate species than hitherto available for most of the sites and therefore provide a baseline for future assessment of change in a limited number of populations. These sites preferably ought to be checked at least 5 yearly, if not more frequently, especially after known management has occurred, as it would be useful to acquire information which could throw light on relationships between the populations concerned and management impacts. At Robin's Wood for example, the cutting of a strip of woodland under pylons to the edge of a gill stream with stems and brash left within centimetres of one colony (presumably unknowingly) apart from being a potentially damaging operation on a SSSI provides an opportunity for observations that could lead to useful information on the fern's response to coppicing. More than 100 stations are known in the Weald and ideally the network of watched sites would be expanded to include a more representative sample. Recent improvements in spatial accuracy of botanical recording mean that there are detailed published records from sites which might be used to develop such a network (e.g. Kitchener 2014).

It is proposed that *Dryopteris aemula* may be useful as an indicator species which can be monitored relatively easily (using a network of accessible sites) for signals of wider change in the gill woodland ecology without the deployment of specialist expertise in bryophyte survey (although more bryological surveys of gills would certainly be a good thing). From the baseline, the populations reported in this study, could be resurveyed reasonably straightforwardly.

11. References

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Appendices

1. Excel spreadsheet: Appendix 1 - field data June 2014.xls
Includes all botanical records from fieldwork in June 2014. 33 worksheets in total. All information is summarised in the first 5 (others are vegetation samples included for information).

2. Excerpts from relevant literature on gills and plant species associated with gill woodland in the Weald.

3. Atlantic range of *Dryopteris aemula* (from Page 1997, The Ferns of Britain and Ireland. 2nd Edition). Plants situated in gills near Cranbrook and Benenden in the Kent High Weald can be regarded as the easternmost colonies of the species in the world.

Appendix 2.

Patmore, J. (n.d.). High Weald Natural Area profile. English Nature, Lewes

[Conservation objectives for gills]

4.2 Gill woodlands and associated streams
Aims: Maintain existing quantity of gill woodlands and enhance their quality for features of interest.
• Identify where the gill woodlands are located and recommend their optimum management for conservation. This will link to improving understanding of their historical management.
• Ensure future planting does not include conifers that may affect the gill.
• Provide mechanisms to help clear rhododendron which has invaded important nature conservation habitats.
• Clarify hydrological patterns and identify high pollution risk areas.
• Ensure pollution is prevented wherever possible.
• Encourage planning departments to refuse planning permission for gill woodland development.

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[Topics suggested for further research]

It has been indicated that there is still a large amount of fundamental research that needs to be undertaken if conservationists are to accurately understand Wealden Gill woodland ecology. The following topics are the main areas that need further investigation.
1. examine the Gill woodland management history since Roman times to determine likely past management history. In particular the extent of coppicing on very steep and deep Gill bank edges.
2. review European plant associations and geomorphologies to assist with placing the Weald Gill woodlands in context.
3. investigate the ecological effects of re-coppicing gills in the light of historical evidence gathered in #1 above.
4. investigate the ecological effects of conifer removal and possible replanting with appropriate species.
5. investigate Gill woodland tree-planting history to determine how ecologically and locally distinct the apparently native tree cover is.
6. measure the water quality of streams affecting Wealden Gills and quantify the likely effect of water quality and quantity on the ecological features.
7. quantify the gill microclimate accurately to enable objective comparisons with other Gill-like features in Britain and Europe.

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The following are excerpts from entries for selected woodland species and a few others which might be associated with woodland (not only gills) habitats.
Annotations:

* indicates a species also on Kent draft Rare Plants Register 2014 (Kitchener 2014)
[] - notes inserted, not pt of published text
fl - flowering periods from various sources

Anagallis minima (L.) E.H.L.Krause (*Centunculus minimus* L.)Chaffweed *
Included here despite having more records than meet the criterion for Sussex Scarce because there are far fewer recent localities for this species than are shown in the map in Hall (1980). As its preferred habitat of damp tracksides in woods is still plentiful it may simply be that it has been overlooked as it is so tiny that it can often not be seen unless the recorder gets down on hands and knees.

fl 6-7

Cardamine bulbifera (L.) Crantz (Dentaria bulbifera L.) *
Coral-root One of the strongholds of this Nationally Scarce plant is in NE Sussex and there are also scattered sites in W. Sussex. In Sussex it is mainly found near paths in ancient woodland, along wooded streams and on road verges on damp fairly acidic Wadhurst Clay and alluvium. It seems to be flourishing with few recent losses, possibly because the main sites are difficult to cultivate or of little agricultural use. Several of the verges where it is found have “Protected for Wildlife” status. A survey of this species in Sussex was carried out by R.A.Nicholson in 2000. There are eight extant localities in W. Sussex (some with several separate colonies) and some large populations (200 – 2000 plants), particularly in the area just N of Horsham. In E. Sussex there are 72 localities with post 1986 records. Due to the large number of records only one record for any 1km square is given.

Chrysosplenium alternifolium L.
Alternate-leaved Golden-saxifrage
This species is known from several sites in wet woodland along the Rother and its tributaries in W. Sussex, not far from similar streams in Hampshire where it is frequent. In E. Sussex was last seen at Groombridge c.1933.

Dryopteris aemula (Aiton) Kuntze *
Hay-scented Buckler-fern
Very rare in W. Sussex but locally frequent in the High Weald area of E. Sussex. This fern likes the shady woods on hard sandstone in the Tunbridge Wells Sand, often found growing with Hymenophyllum tunbrigense. It was first recorded in E. Sussex in 1845 on the Eridge Rocks.

In W. Sussex a good colony with 10 plants on a bank at Chithurst was last seen in 1991, but not refound on two thorough searches since so possibly extinct in the vice county of W. Sussex. This species is noted in Wigginton (1999) as one for which Britain has special responsibility.

Location Grid Ref. Last seen Native Rec. Comments
Chithurst SU8--2-- 1991 Yes FR Chithurst
Staplefield TQ290293 1994 Yes SR* Rocks in Northland Wood
Near Sharpthorne TQ394315 1994 Yes TCGR Horncastle Wood, by stream
Hindleap Warren TQ411328 1994 Yes TCGR Ghyll
Chelwood TQ423288 1994 Yes PAH Wet ghyll wood
Chelwood TQ426288 1994 Yes PAH Wet ghyll wood
Broadstone Warren TQ430332 1994 Yes TCGR Stream
Ashdown Forest TQ432315 1995 Yes TCGR Southbank Wood
Chelwood TQ436309 1995 Yes CPJC West Wood
Pippingford Park TQ438309 1995 Yes SBRS Ghyll
E of Duddleswell Manor TQ472285 1995 Yes TCGR Ghyll
Friars Gate TQ488332 1995 Yes PHW Bank of stream, Pump Barn cottages
Crowborough TQ502325 1994 Yes TCGR Bank, Keywoods Wood
Frant TQ577335 1994 Yes TCGR Rocks, Saxonbury Hill
- TQ6--1-- >1986 Yes - -
Dallington Forest TQ647203 1999 Yes RAN Wooded ghyll
- TQ7--1-- >1986 Yes - -
- TQ7--2-- >1986 Yes - -

spores ripening July-September

Equisetum sylvaticum L. *
Wood Horse-tail
This plant has always been rare in Sussex and, although there are several records in Briggs (1990) from the Weald in E. Sussex, none has been seen there recently. In its few W. Sussex sites it occurs in wet woodland and, rarely, in sheltered areas in damp grassland.

Location Grid Ref. Last seen Native Rec. Comments
Shottermill SU881324 1998 Yes FA Wet hollow, National Trust field
River SU935231 1997 Yes SMS Woodland clearing
Ebernoe SU968279 1997 Yes FA Locally common in small damp wood

cones ripe May, sterile stems present May-October

Festuca altissima All.
Wood Fescue
This very rare and beautiful native grass is currently restricted to two sites in E. Sussex, both of which were found by F.Rose. It has been known at Ashurstwood since 1955. W-Dod (1937) also gives two records for E. Sussex but in different places to the present sites.

Location Grid Ref. Last seen Native Rec. Comments
Ashurstwood TQ41-37- 1993 Yes PAH Mills Rocks (Private land)
Dallington TQ65-20- 2000 Yes HMP/PAH Above Cox's Mill

fl 6-7

Gnaphalium sylvaticum L. (Omalotheca sylvatica (L.) Schultz-Bip. & F.Shultz) *
Heath Cudweed
This species was formerly fairly widespread in E. Sussex, but has not been recorded there recently. However, it still occurs in a few W. Sussex woodlands on sand or chalk.

fl 7-9

Hymenophyllum tunbrigense (L.) Sm.
Tunbridge Filmy-fern
First recorded in 1686 by Dr. Dare at Tunbridge Wells but has been extinct there since at least 1875. There are scattered localities in the High Weald where it was feared that the devastation wrought by the great storm of October 1987 would cause the demise of many sites. In 1994 a survey of known sites, carried out to ascertain the status of the Tunbridge Filmyfern, found a number of healthy colonies, some showing an increase in numbers. This species is noted in Wigginton (1999) as one for which Britain has special responsibility.

Location Grid Ref. Last seen Native Rec. Comments
Handcross TQ272296 2000 Yes AGH Sandstone rocks, 3 patches, increasing
Northlands Wood TQ290293 1995 Yes TCGR Shaded wet sandstone rocks
Balcombe Mill TQ318304 1994 Yes SR* Sandstone rocks
Wakehurst Place TQ334311 1994 Yes SR* Tilgate Wood, sandstone rocks
Wakehurst Place TQ335311 1994 Yes SR* West Wood, sandstone rock by path
Philpots, Ardingly TQ34-32- 1994 Yes SR* Sandstone rocks
West Hoathly TQ348322 1994 Yes TCGR Chiddingly Wood, sandstone rocks
Fairwarp TQ473260 1995 Yes RDR* Furnace Wood, sandstone rocks
Motts Mill TQ523350 1994 Yes SR* Rocks Wood, sandstone rocks
Motts Mill TQ527352 1994 Yes SR* Leys Wood, sandstone rocks
Eridge Rocks TQ555355 1994 Yes SR* Sandstone rocks. SWT Reserve
Frant TQ577335 1994 Yes SR* Saxonbury Hill, sandstone rocks

Lobelia urens L. *
Heath Lobelia.
This species has decreased rapidly in numbers in the southern coastal counties of England. In Sussex the first and only record is from Flimwell 1925, Mrs E.E.Johnson, E.J.Bedford and conf. A.J.Wilmott (Journ. Bot. 1925,26) where it is still to be found in several places. Growing in open woodland, the populations of Lobelia urens fluctuate from year to year, rising markedly with the increase of light following coppicing. This site, which is very close to the E. Sussex/Kent border is in the Watsonian vice county of Kent (VC15), not the Watsonian vice

county of E. Sussex (VC14) but is included here because it is in the administrative county of E. Sussex.

Location Grid Ref. Last seen Native Rec. Comments
Flimwell TQ719307 1999 Yes AGK Footpath east of Bird Park

fl 8-9

Osmunda regalis L. *
Royal Fern
The Victorian fern collecting craze, abetted by habitat loss, has cleared Royal Fern as a native from virtually the whole of Sussex. Hall (1980) regards Ashdown Forest (E. Sussex) as probably the only area where it may be regarded as native and Rich *et al*. (1996) details the situation there in the early 1990s. Elsewhere in both W. and E. Sussex plants seem likely to be of garden origin. Only the native records are given here.
Location Grid Ref. Last seen Native Rec. Comments
Ashdown Forest TQ422308 1991 Yes C&NM E of Isle of Thorns
Ashdown Forest TQ423305 1991 Yes C&NM E of Isle of Thorns
Broadstone Warren TQ429330 1995 Yes CM Large fertile clumps
St. Johns TQ506324 1994 Yes TCGR Near Hoadley's Farm, now gone

[Note: the less-well-known Hargate Forest plants may be analogous with Rich's Ashdown Forest ones which are regarded as the last native plants in Sussex]

spores ripening June-July

Phyteuma spicatum L.
Spiked Rampion
This species, with its tall spikes of white flowers, is entirely confined to E. Sussex. There are numerous records of its occurrence in woodlands and hedgerows of the Low Weald during the late 1800s and early 1900s. Today, however, both the number of sites and the number of plants have greatly declined. Phyteuma spicatum has become a considerable rarity, confined to seven sites in the Heathfield area and a single wood near Hailsham. The reduction in the number of suitable habitats caused by the demise of traditional land management, coupled with low seed survival, are believed to have contributed to the decline of this attractive plant. There are now fewer than five hundred known plants (BW), and management of the remaining sites is urgent for the survival of this species. There are eleven additional old records from specimens lodged with the Liverpool Museum Herbarium. However, none of these specifies a location although all have been attributed to recorders. On the continent this species is a common plant of roadside banks and mountain meadows.

[Note: not really a woodland plant but can be associated with Wealden gills (edges)]

fl 5-6

Pimpinella major
Greater Burnet-saxifrage
In the first half of the 20th century this plant was known to be locally common in Kent and Surrey, but described by W-Dod (1937) as 'strangely rare in Sussex'. Apart from a few doubtful records, it was known in the Wilmington-Folkington-Polegate area since 1879, but currently is known from one site only in E. Sussex - a small copse between Wannock and Folkington (not near Jevington as in Hall (1980)). Recorded in this area c.1980 by CLA and found by DLV at the present site, there were eight plants in 1984 but only three between 1995 and 2000. These few plants are at risk with the woodland becoming more dense and from the encroachment of coarse vegetation.

[Note: frequent across N Downs into Low Weald of Kent but rare in Sussex and High Weald, but, there are a number of records in the Kent part of the AONB near Cranbrook/Benenden]

fl 6-7

Ranunculus omiophyllus Ten. (R. lenormandii F.W.Schultz)
Round-leaved Crowfoot
First recorded from slow streams in St. Leonards Forest in 1849 and with over 30 scattered sites listed in W-Dod (1937), it is now more restricted to the acid soils of the High Weald area of Ashdown and St. Leonards Forests. Once known in a number of places in shallow woodland streams in the area around Crawley and Horsham it is now found there much less often. For a more detailed account of the species see Flora of Ashdown Forest (Rich *et al*.1996).

fl 5-9

Sibthorpia europaea L.
Cornish Moneywort
Nationally scarce, with main distribution in Cornwall and Devon. A plant of shady banks usually near streams, only known from E. Sussex where it has been known since 1833 in a few localities, but in these at one time locally abundant. It has however decreased but there are recent native records at Cross-in-Hand and at Herstmonceux where it has been long known and was recorded by J.Hilton of Brighton c.1900.

fl 7-10

Trichomanes speciosum Willd. (gametophyte)
Killarney Fern
Known in Sussex only in the gametophyte state, this fern was first detected in Fairlight Glen near Hastings in 1992. It has subsequently been found in other localities in E. Sussex. (Watsonia, 22,1-19).

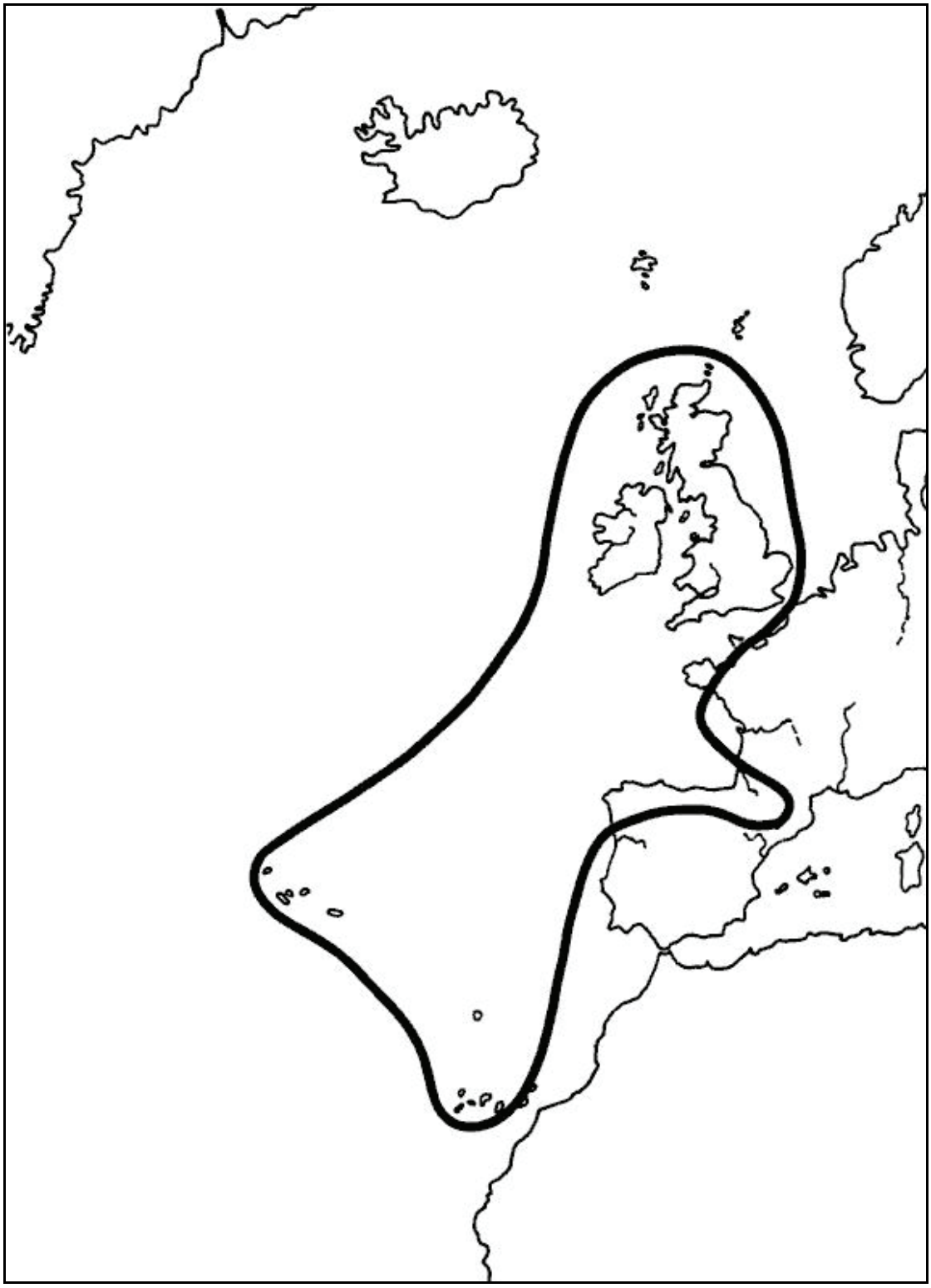
Kitchener, G. (2014). Kent Rare Plant Register (in draft) Compiled by Geoffrey Kitchener and the Kent Botanical Recording Group. Available: http://bsbi.org.uk/kent.html

additional species not mentioned in Briggs (ed) above:

Radiola linoides
Habitat: "damp bare acid sandy ground on heaths and on paths in woods"
High Weald (with New Forest) seems to be a very significant headquarters for its distribution in S and E England.
fl 7-8

Wahlenbergia hederacea **not** mentioned in Sussex RPR (in Kent RPR draft 2014)
[this is frequent in western High Weald - or WFR area - but app. rare elsewhere in AONB (and E England) and could is considered a gill character species]
fl 7-8

Appendix 3.



Atlantic range of *Dryopteris aemula* (from Page 1997). Plants situated in gills near Cranbrook and Benenden in the Kent High Weald are the easternmost colonies of the species in the world.