

3 Distribution and conservation value

3.1 Distribution and extent of scrub types in Britain

3.1.1 Scrub distribution

There is no available map or dataset that accurately represents the distribution of scrub communities in the British Isles. This is partly because scrub is mostly impermanent and often has imprecise boundaries, but mainly because scrub is difficult to define or classify from remote sensed images. Thus the ITE Land Cover Map (LCM), which is based on remote sensing of land cover, cannot be used with adequate precision for identifying the occurrence of scrub. The best available indication of nation-wide scrub cover is probably provided by the ITE Countryside Information System (CIS), which predicts the occurrence of 'shrub' in each 1km square based on its occurrence in similar squares from among the 570 sampled in the 1990 Countryside Survey (CS90). This information is presented in map form in Figure 3.1. The definition of shrub used is: 'Woody vegetation predominantly of shrubby species (even if >5 m high) often with tree regeneration and brambles with a canopy cover of > 50%. Dry shrub contains species such as hawthorn *Crataegus monogyna*, blackthorn *Prunus spinosa*, grey willow *Salix cinerea*, dog rose *Rosa canina*, gorse *Ulex europaeus*, broom *Sarothamnus scoparius*, and includes dune scrub dominated by such species as sea-buckthorn *Hippophae rhamnoides*. Swampy shrub and carr comprises semi-natural shrub growing on waterlogged substrate, particularly peat. Species include willows *Salix* spp. and alder buckthorn *Frangula alnus*. The map does not include carr woodland, dominated by such species as downy birch *Betula pubescens* and common alder *Alnus glutinosa*, which is included in the broadleaved woodland category.

The map (Figure 3.1) indicates that in 1987-8 (the date of the survey), scrub occurred most frequently on calcareous soils in the south of England, around the coasts of south-west England and Wales, and on marginal lands in the uplands throughout Great Britain. The general pattern of distribution is unlikely to have changed over the past 12 years, although there may have been some regional changes in scrub area due to changes in grazing pressures.

3.1.2 Occurrence of individual scrub types

Scrub is a major habitat type on the chalk and limestone in the south of England and to a lesser extent the calcareous soils in the Peak District. The most widely distributed NVC communities in these situations are the *Crataegus monogyna-Hedera helix* (W21) and *Prunus spinosa-Rubus fruticosus* (W22) scrub communities (Rodwell 1991a). These communities also occur on neutral soils including quite heavy clays in the south of England. In some places on the chalk, especially on steeply-sloping, south-facing ground NVC community W13 (*Taxus baccata* woodland) occurs. It frequently displaces juniper *Juniperus communis* scrub, the yew seedlings being protected by the mature juniper bushes. Although the stands of W13 may be very long-lived the individual yews rarely exceed 10 m in height and the vegetation has the appearance of scrub. The equivalent hawthorn scrub to W21 in the uplands is not given an individual NVC community or sub-community type, although it may be considered to be a characteristic component of U20 (*Pteridium aquilinum-Galium saxatile*) community. This scrub type, in which hawthorn bushes, and to a lesser extent other shrubs (hazel *Corylus avellana*, crab apple *Malus sylvestris*, blackthorn and holly *Ilex aquifolium*), are scattered among bracken *Pteridium*

aquilinum, generally occurs on steeply-sloping marginal land. It is very widespread throughout the uplands of England and Wales, but is much less common in Scotland. In many cases upland hawthorn scrub appears to be a plagio-climax community rather than a seral stage to woodland since research has shown that some stands are centuries old (Good *et al.* 1990). Ironically, because the hawthorn bushes often comprise <50% of land cover, the community which is dominated both visually and ecologically by their presence is described as grassland rather than scrub.

Scrub, mainly dominated by birch *Betula* spp. and gorse (W23 *Ulex europaeus-Rubus fruticosus* scrub) occurs widely on acid heathlands and lowland commons throughout the south and west of England and Wales. It often forms a mosaic with heathland and acid grassland, the extent and species composition of the scrub component varying depending on location with soil type, surrounding vegetation and exposure influencing it. Scrub on heathland adjacent to native broadleaved woodland may be rapidly colonised by oak *Quercus* spp., while on sites where seed is available from nearby plantations or adjacent more mature scrub, Scots pine *Pinus sylvestris* may invade and take over the site.

Gorse scrub may also be found around the coast where it may invade many communities on base-poor soils if the opportunity is afforded by decline of agricultural usage. The other common coastal scrub community on more base-rich soils is W22 which is common on cliffs and which often spreads inland where grazing is light or lacking. It often forms a mosaic with various heath communities, notably H7 *Calluna vulgaris-Scilla verna* (maritime heath) (which also occurs on the west coast of Scotland and the inner and outer isles), H8 *Calluna vulgaris-Ulex gallii* heath and, to a lesser extent H12 *Calluna vulgari-Vaccinium myrtillus* heath. On soft coasts scrub dominated by sea-buckthorn (SD18 *Hippophae rhamnoides* scrub) is widespread, often having been planted for stabilisation of dunes. It is often regarded as having a largely deleterious influence but a detailed study in the 1970's (Ranwell 1972) suggested that it has benefits as well, providing shelter for a wide range of plants and animals. Hawthorn scrub may also 'invade' dune systems, as happened on a wide scale following the decimation of rabbit populations by myxomatosis from the mid-1950's onwards. The progress of hawthorn scrub development at Newborough Warren on Anglesey and the resultant nitrogen and phosphorus enrichment of topsoil were recorded by Hodgkin (1984).

On wetter inland sites in the south of England willow carr (W1 *Salix cinerea-Galium palustre* and W2 *Salix cinerea-Betula pubescens-Phragmites australis* woodlands) are an important and widely distributed scrub woodland types. In northern Britain, scrubby woodland of W3 *Salix pentandra-Carex rostrata* woodland occupies similar sites. Alder and birch woodlands (W4 *Betula pubescens-Molinia caerulea*, W5 *Alnus glutinosa-Carex paniculata*, W6 *Alnus glutinosa-Urtica dioica* and W7 *Fraxinus excelsior-Lysimachia nemorum* woodlands), while not strictly scrub often have a scrubby appearance and structure. W4 and W7 are found mainly in the north and west of England and Wales, W5 and W6 predominantly in the south.

Some scrub types, notably W20 (*Salix lapponum-Luzula sylvatica* scrub), W19 (*Juniperus communis-Oxalis acetosella* woodland), and box *Buxus* scrub have conservation interests disproportionate to their very small ranges, in part because they probably represent remnants of communities which were once much more widespread.

The nature conservation value of scrub in Britain

In Scotland there is considerable interest in the conservation of scrub communities, several of which are rare and/or threatened, often as a result of overgrazing (Hester 1995). Data from the Scottish National Countryside Monitoring Scheme shows only 2% scrub cover in the 1970s, with Grampian Region containing the most extensive scrub communities. The total area of scrub in Scotland is unlikely to have changed substantially since then. However, more recent surveys provided detailed information on the distribution and extent of montane scrub in north-west Scotland (MacKenzie 1996) and in east, west and south Scotland and the Northern Isles (MacKenzie 1999). MacKenzie is currently collating all known information on high altitude and coastal Scottish scrub (D. Gilbert *pers. comm.*). This work has highlighted the variability of information available, particularly the lack of information on the size and condition of sites. In some cases a four figure grid reference is the only available information. Several recent studies have provided additional, more detailed information on the distribution and abundance of juniper scrub in different parts of Scotland including the Borders (McBride 1997) and Fair Isle (Riddiford 1997).

The high altitude (350-500 m) area of birch and juniper at Morrone in NE Scotland is probably the nearest equivalent in Britain to the extensive Scandinavian sub-alpine birch/juniper scrub (Hester 1995). Many of the birch are contorted and <5 m tall (Ratcliffe 1977, Huntley & Birks 1979a, 1979b). French *et al.* (1997) report the recent development of high altitude Scots pine scrub in the northern Cairngorm mountains following reduction in grazing and browsing and suggest that a natural subalpine scrub zone appears to be developing. Most of the natural scrub remaining on the islands to the north and west of Scotland has sub-alpine affinities due to extreme exposure (McVean 1964).

3.1.3 Sources and reliability of information

There is little information held by the country agencies on distribution or abundance of scrub on a national or local basis due to imprecise definitions and boundaries, and compounded by the former lack of interest in scrub.

Where scrub occurs in SSSIs and other designated areas in England, it is usually mentioned but is not quantified (as it is in the SSSI databases for Scotland and Wales). Management prescriptions for sites rarely include scrub management, with the exception of recommendations for its control or removal.

According to the ITE Countryside Information System, in 1990 approximately 43,000 1 km squares (18% of the total rural squares) contained > 0.5 ha but <4.1 ha of scrub. The total area of scrub in Great Britain in 1990 was estimated to be 900 km² (± 200 km²) of which 600 km² (± 100 km²) was in England, 200 km² (± 50 km²) was in Scotland and 100 km² (± 50 km²) was in Wales. More detailed figures for particular scrub types reside within the CS1990 and CS2000 databases, but it is beyond the scope of this study to extract and present that data. A comprehensive review is due to be published soon of the distribution and extent of scrub communities in Scotland, building on earlier reviews (MacKenzie 1996, 1999, Gilbert *pers. comm.*).

Figure 3.1 Predicted distribution of shrub from the Countryside Information System (Version 6.0).

3.1.4 Occurrence on protected sites

3.1.4.1 Nature Conservation Review (NCR) sites

The Nature Conservation Review (Ratcliffe 1977) provides some information on the distribution and nature conservation value of scrub habitats. Several scrub types are included in the woodland section of the review, however, information on the importance of scrub in these sites is difficult to gather from the published information. Tabular information is presented on the occurrence of scrub of nature conservation value in lowland grasslands, heathlands and coastal areas. This information is shown in Appendix 3.1. Scrub on many of these lowland sites is seral, and since the survey work for the NCR took place over 30 years ago, the continued conservation value of scrub communities on these sites cannot be assumed.

3.1.4.2 Sites of Special Scientific Interest (SSSIs)

Site descriptions held by the countryside agencies English Nature (EN), Scottish Natural Heritage (SNH) and Countryside Commission for Wales (CCW) for SSSIs provide a more useful indication of scrub distribution. These data indicate where scrub is a feature, and in some cases quantify scrub area. The data for England refers only to locations and is shown by major shrub types in Figures 3.2-3.7.

The distribution of SSSIs with calcareous scrub, mainly W21 *Crataegus monogyna-Hedera helix* scrub (Figure 3.2) seems to give a good representation of the major chalk and limestone areas in England, picking out the chalk of the North Downs, South Downs and Chilterns, the Oolitic limestone of the Cotswolds, Northamptonshire and Lincolnshire Wolds, and further north the Carboniferous limestone of Derbyshire, Yorkshire and the Lake District.

The distribution of lowland acid scrub dominated by gorse (W23 *Ulex europaeus-Rubus fruticosus* scrub) in SSSIs is shown in Figure 3.3. Its distribution, to a considerable extent, complements that of calcareous scrub (Figure 3.2) with concentrations in Cornwall, the Isle of Wight, and on freely drained non-calcareous soils in eastern England.

The distribution of lowland neutral scrub (predominantly W22 *Prunus spinosa-Rubus fruticosus* scrub) on SSSIs (Figure 3.4) picks out the deeper, moister and more fertile soils in Worcestershire, Warwickshire, Nottinghamshire and Lincolnshire, with scattered representation on the London Clay in the Home Counties. On some SSSIs, both calcareous scrub and neutral scrub occur on the same sites as there is often an imperceptible intergrading between hawthorn-dominated scrub (W21) and blackthorn-dominated communities (W22). Wetland scrub (W1 *Salix cinerea-Galium palustre*, W2 *Salix cinerea-Betula pubescens*, W3 *Salix pentandra-Carex rostrata*) on SSSIs is shown in Figure 3.5. These sites are concentrated in such areas as the Norfolk Broads, the Lake District and in Cornwall, with scattered sites in wetland areas elsewhere in

England. The scrub is often a small component, for example where it forms fringing vegetation around lakes and fens.

It can be seen that most coastal SSSIs with scrub as a feature (Figure 3.6) are located in the south and west of England. Their distribution broadly follows that of hard rock coasts, where scrub is often found on sea cliffs, and soft coasts around tidal estuaries and on dune systems, for example along the coast of Lancashire.

Juniper *Juniperus communis* scrub is probably more fully represented within the SSSI network in England than any other type.

Figure 3.7 clearly shows its distribution in the north of England and in the few areas where it occurs on calcareous soils in the south.

The distribution of scrub within SSSIs in Scotland and Wales is shown in Figures 3.8-3.11. For these countries, SSSI records do not generally indicate scrub type (NVC community). However, data on the area of scrub on each site have been extracted (Figures 3.8 and 3.10) and from these, the proportion of the area of each SSSI which is scrub has been calculated (Figures 3.9 and 3.11).

It can be seen that in Scotland most of the SSSIs with scrub mentioned as a component habitat are in the eastern central zone around the Firth of Forth and the southern highlands (Figure 3.8). Lesser concentrations are to be found in Berwickshire and Peebleshire and around the Cromarty Firth. Sites with large areas of scrub (>50 ha) are few in number and restricted to the west and north-east of Scotland. There are many sites where scrub exceeds 10% of the area, but only four where greater than 50% is scrub (Figure 3.9).

SSSIs with scrub in Wales show a more scattered distribution than in Scotland (Figure 3.10) although there are concentrations in Cardiganshire, Pembrokeshire and Anglesey. Most of the sites with appreciable areas of scrub are on or near the coast. Looking at the proportion of scrub in each SSSI we see (Figure 3.11) that, as in Scotland, there are many sites in Wales where scrub exceeds 10% of SSSI area but only a few where greater than 50% is scrub.

These maps show only the 'bare bones' of scrub distribution within SSSIs in the three countries. As we do not know the overall distribution and extent of different scrub communities, many of which are in any case constantly changing as a result of scrub clearance and successional processes, it is difficult to determine whether scrub is adequately represented within the individual country site networks. If it is, then except in the cases of such historically valued communities as juniper scrub, and montane willow scrub in Scotland, this is likely to be more by chance than design, since scrub is nearly always an incidental inclusion within SSSIs established primarily to protect other habitats.

3.1.4.3 Special Areas of Conservation (SACs)

Of the currently designated Special Areas of Conservation, about 25% contain scrub habitats of conservation importance. These sites are listed in Appendix 3.2, together with the scrub habitat types occurring on each sites according to classification used in Annex I of the Habitats Directive.

The nature conservation value of scrub in Britain

Figure 3.2 Distribution of scrub on dry lowland calcareous soils (NVC type W21) in Sites of Special Scientific Interest in England.

Figure 3.3 Distribution of scrub on dry lowland acidic soils (NVC type W23) in Sites of Special Scientific Interest in England.

Figure 3.4 Distribution of scrub on dry lowland circumneutral soils (NVC type W22) in Sites of Special Scientific Interest in England.

Figure 3.5 Distribution of scrub on wetland soils (NVC types W1, W2, W3) in Sites of Special Scientific Interest in England.

Figure 3.6 Distribution of scrub on coastal in Sites of Special Scientific Interest in England.

Figure 3.7 Distribution of scrub on juniper scrub (NVC types W19, W21d) in Sites of Special Scientific Interest in England.

Figure 3.8 Distribution of scrub on Sites of Special Scientific Interest in Scotland, showing absolute area of scrub.

Figure 3.9 Distribution of scrub on Sites of Special Scientific Interest in Scotland, showing scrub as a proportion of total site area.

Figure 3.10 Distribution of scrub on Sites of Special Scientific Interest in Wales, showing absolute area of scrub.

Figure 3.11 Distribution of scrub on Sites of Special Scientific Interest in Wales, showing scrub as a proportion of total site area.

3.1.5 Digitised data held on Geographical Information Systems

Geographical Information Systems (GIS) are now commonly used by local authorities and non-governmental organisations to store and analyse information on habitat distribution. Geographical coverage, level of detail of information and types of analysis performed vary greatly between organisations. The Chilterns Area of Outstanding Natural Beauty (AONB) has been used as a case study to examine the range of organisations holding digital data relevant to scrub conservation on a GIS, and the availability of these data.

3.1.5.1 Case Study: Chilterns AONB

The Chilterns AONB covers 833 km² of the Chiltern Hills, extending along a NE - SW axis between Hitchin and Reading, and includes parts of Bedfordshire, Buckinghamshire, Hertfordshire and Oxfordshire (Chilterns Conference 1994). The Chilterns are a nationally important landscape, defined by the underlying chalk geology, containing large areas of chalk grassland (Steven & Biron 1992). Chalk scrub in the Chilterns is frequently species rich (Smith 1980) and valued as a habitat for invertebrates such as the nationally scarce Duke of Burgundy *Hamearis lucina*. The role of chalk scrub as a valued resource is reflected in the number of scheduled sites of nature conservation importance in the Chilterns which include scrub as 'an attractive and important feature in its own right' (English Nature undated, Chilterns Conference 1994). Nevertheless, careful management is needed as scrub may rapidly encroach on to, and subsequently reduce the nature conservation value of, adjacent chalk grasslands.

There is considerable interest in scrub conservation in the Chilterns (English Nature 1999), which is reflected in the volume of data held on GIS (Table 3.1). Data are available from a range of sources, primarily aerial photographs (English Nature, Oxford Brookes University) and site surveys (Buckinghamshire County Council, Hertfordshire Biological Records Centre). The potential level of use of GIS varies greatly between organisations, for example

the Hertfordshire Biological Records Centre holds only site outlines within the GIS, referring the operator to more detailed data files held on their Site Database stored on Recorder. In contrast, the English Nature and Oxford Brookes University Geographical Information Systems hold site-specific data including type and percentage cover of scrub. Both operating systems are capable of displaying geographical distribution of records on base maps, but Arc/Info provides a more powerful tool for analysis of the landscape-scale processes which are likely to influence scrub conservation in the Chilterns.

The value of the Geographical Information Systems in use is limited by the amount of data held in digital format, and the availability of resources to transfer existing data from computer databases and paper files into suitable GIS format. These constraints operate on most of the organisations using GIS, and are not specific to the Chilterns. As with many conservation projects, lack of communication and exchange of information are also issues, and in the past have resulted in the duplication of digitising effort between organisations. This is currently being addressed by the Chilterns AONB Officer. Funding is being sought to co-ordinate GIS resources throughout the AONB, and create a centralised repository of habitat data for the Chilterns AONB held on GIS. Storage and manipulation on a GIS with a powerful operating system such as Arc/Info would enable maximum use of these data.

All of the operating systems used to store and manipulate scrub data relevant to the Chilterns AONB are sufficiently sophisticated to enable data exchange between systems, although transformation into compatible export files may be required. All organisations surveyed were willing to make data held on their GIS available to other user groups, particularly Wildlife Trusts, other conservation organisations and research organisations such as universities. A charge to cover staff time would be expected, although only the Hertfordshire Biological Records Centre has existing guidelines on charges. Most organisations currently deal with applications on an *ad hoc* basis, and address questions of charges, confidentiality and the implications of inputting costs on an individual basis.

Table 3.1 Information on scrub distribution and characteristics in the Chilterns held on Geographical Information System

<i>Organisation</i>	<i>Details</i>	<i>System</i>	<i>Access</i>
Buckinghamshire County Council	The Biological Notification Site Register for Buckinghamshire is digitised, and can be queried to identify sites with scrub in the Chilterns AONB. The GIS holds details on each site, including survey date, ownership and co-ordinates. Further information on scrub types, species composition is available by referring to the BNSR paper copy. All Sites of Importance for Nature Conservation in Buckinghamshire will be digitised by end March 2000.	Arc/Info, viewed in Arc/view	Access negotiable, some charge may be made.
English Nature Chilterns Team	Distribution of chalk scrub in the Chilterns Natural Area in 1973 and 1995. Digitised from aerial photographs at a scale of 1:50,000 (Redgrave 1996). Scrub categorised by percentage cover (4 categories) and scrub type (12 categories).	MapInfo	Some charge may be made for accessing this information.
FRCA	Small areas digitised for Countryside Stewardship Agreement map purposes only.	Arc/Info	No access.
GIS Habitat Research Group, Oxford Brookes University	Distribution of chalk scrub in the Chilterns Natural Area digitised from aerial photographs (Redgrave 1996) (as EN above). A separate study of all land use, including scrub, also digitised from aerial photographs at a scale of 1:10,000, covering 525 km ² of the AONB (Oxfordshire 1992, Buckinghamshire 1995).	Arc/Info	No procedure for access in place. Queries regarding Redgrave's survey data would be referred to EN.
Hertfordshire Biological Record Centre	Site outlines digitised for all sites where field surveys have been carried out. Site outlines linked to Recorder site database, which holds site information including habitat characteristics and descriptions. Key words can be used to find distribution of habitats e.g. scrub (RSNC habitat classification system).	Arc/Info, viewed in Arc/view	Commercial and non-sponsoring organisations: £46 per hour. Members of the public, conservation organisations and other organisations with a service level agreement with HBRC: no charge.
Oxfordshire County Council	Some information on scrub held on GIS (further information currently unavailable)	Contact for details	Contact for details.
Wycombe District Council	No scrub data. Colour aerial photographs of relevant sections of AONB soon to be digitised onto GIS.	MapInfo	

3.2 Conservation value of scrub

The information in this section comprises a review of published literature, complemented by information obtained from unpublished sources and responses to the questionnaire. Information in single quotation marks refers to remarks made by questionnaire respondents (see Appendices 5.3-5.5). To avoid large numbers of references to individuals and unnecessary and inappropriate personalisation, these responses are presented anonymously. Where necessary for the sake of clarity, the geographical location to which comments refer is reported.

3.2.1 Vascular plants

Most scrub in Britain is sub-climax woody vegetation, although in places (sea cliffs, mountain tops, areas remote from seed of larger tree species) it may effectively be climax vegetation. Scrub is often valued as a diversifying element in predominantly grassland, or woodland, areas. For example:

'The Yorkshire Dales are generally heavily grazed by sheep and rabbits, so there is very little tall vegetation and/or scrub. As a result we see significant increases in scrub cover as important for structural diversity and for associated flora and fauna'.

'(Scrub is an..) important component of semi-natural ecotones and habitat mosaics (contributes to habitat structure, microclimate diversity, food source etc)'.

'Scattered scrub is a distinctive component of the downland landscape in the Chilterns'.

It is important to realise that the scrub sites which are most 'valuable' for conservation (i.e. those with greatest biodiversity) are generally open, patchy scrub rather than closed scrub.

Some scrub types are important vegetation communities in their own right e.g. W8g hazel *Corylus avellana* scrub (W8g), western gorse *Ulex gallii* (H8) scrub and the wayfaring-tree *Viburnum lantana* sub-community of *Crataegus monogyna*-*Hedera helix* scrub (W21d). 'Southern mixed scrub' (*sensu* Ward 1974) may have many native shrub species, including spindle *Euonymus europaeus*, hawthorn, buckthorn *Rhamnus cathartica*, blackthorn, wayfaring-tree *Viburnum lantana*, wild privet *Ligustrum vulgare*, gorse, ash *Fraxinus excelsior*, yew *Taxus baccata* and common whitebeam *Sorbus aria*. Hopkins (1996) comments that, 'Such diverse scrub is often rich in rare plants and invertebrates and accounts for a significant part of the conservation value of areas such as the North Downs, Chilterns and Morecambe Bay'.

In Scotland alpine willow scrub communities (defined as occurring above the natural treeline), though widely scattered and often providing patchy cover, are considered important components of native vegetation which merit positive conservation action (Horsfield & Thompson 1997). These communities generally contain a mix of several high altitude dwarf willow species, often with *Salix lapponum* most abundant but also including some or all of woolly willow *S. lanata*, mountain willow *S. arbuscula*, dark-leaved willow *S. myrsinites* and net-leaved willow *S. reticulata* (Matthews 1955, Ratcliffe 1977). Although these willow species are generally limited to ungrazed areas, especially cliff ledges, there is evidence that they can spread into a range of other high altitude communities if grazing is excluded or controlled (Rae 1996). This is being done in a few trial areas in the Highlands as part of the Millennium Forest for Scotland Montane Shrub Project (Gilbert 1997). Woolly willow is a Red Data Book species, being the least widely distributed of these species in Scotland.

Dwarf birch *Betula nana* grows in quite different situations to the dwarf willows, generally being found on flat and gently sloping blanket peatland sites growing in blanket mire (M19 *Calluna-vulgaris*-*Eriophorum vaginatum*) or wet heath (M15 *Scirpus cespitosus*-*Erica tetralix*, M17 *Scirpus cespitosus*-*Eriophorum*

vaginatum) communities. It is a nationally scarce species and one that is easily missed because in Britain grazing reduces its height growth to that of the dwarf shrubs amongst which it grows. In other parts of its circumpolar range where grazing is less severe dwarf birch attains heights of a metre or more (Scott 1997). There is currently no restoration project for dwarf birch scrub as it is not thought to be as severely threatened as willow scrub, since it is a component species in a wide range of plant communities. However, reduced grazing and burning would probably enhance its status within many areas of peatland (Horsfield & Thompson 1997).

Juniper occurs in two scrub communities in Scotland. *Juniperus communis-Oxalis* (W19) scrub is found mainly at high elevation (although generally at or below the treeline) in the eastern Highlands but also occurs at low elevations in the Southern Uplands. *Calluna-Juniperus communis ssp. nana* heath (H15) is confined to the northwest Highlands and Islands, where it is known from six SSSIs.

Several NVC scrub communities are considered important for ground flora as well as their woody component. Hopkins (1996) lists 34 rare and local plant species particularly associated with scrub and related habitats in Britain. Red Data Book and Nationally Scarce vascular plant species associated with scrub and woodland edge habitats are listed in Table 3.2. The distribution of these rare plant species of scrub habitats are shown in Figure 3.12 (pre 1970 records) and Figure 3.13 (post 1970 records). The maps highlight areas with important scrub communities. The importance of scrub on calcareous soils is clear from the maps. Many rare scrub plants being found on the chalk (North Downs, South Downs, Chilterns) and Carboniferous limestone (Avon Valley, Wye Valley, Peak District, Great Orme, Craven and Morecambe Bay) outcrops. The importance of coastal scrub on the south-west peninsula is also noteworthy. Finally, the alpine and sub-alpine scrub of the Scottish Highlands provides habitat for a number of rare scrub plants.

Responses to the questionnaire survey of land managers showed that some species were valued primarily as food plants for invertebrates. One questionnaire respondent mentioned coppicing birch to allow marsh violet *Viola palustris* to flourish for the benefit of the small pearl-bordered fritillary *Boloria selene*, several were managing blackthorn for black hairstreak *Strymonidia pruni* and brown hairstreak *Thecla betulae* butterflies. The Duke of Burgundy butterfly *Hamearis lucina* lays its eggs on cowslips *Primula veris* which grow in the sheltered herb-rich 'saum' vegetation found on scrub margins.

Table 3.2 Red data book and nationally scarce species of vascular plant associated with scrub or woodland edge habitats.					
<i>Scientific name</i>	<i>English name</i>	<i>Occurrence in NVC types (where mentioned in NVC)</i>	<i>Status</i>	<i>BAP</i>	<i>S8</i>
<i>Aceras anthropophorum</i>	Man Orchid	CG2, CG3, CG5	NS		
<i>Actaea spicata</i>	Baneberry		NS		
<i>Althaea hirsuta</i>	Rough Marsh-mallow		RDB en	SCC	S8
<i>Arum italicum neglectum</i>	Italian Lords-and-Ladies		NS		
<i>Bromus benekenii</i>	Lesser Hairy-brome		NS		
<i>Buxus sempervirens</i>	Box	W12,W13	NTS	SCC	
<i>Calystegia sepium roseata</i>	Hedge Bindweed		NS		
<i>Campanula patula</i>	Spreading Bellflower		NS		
<i>Carex appropinquata</i>	Fibrous Tussock-sedge	W3,W5, M9	NS		
<i>Carex atrata</i>	Black Alpine-sedge	W20, CG14, U17	NS		
<i>Carex depauperata</i>	Starved Wood-sedge		RDB cr	SCC	S8
<i>Carex digitata</i>	Fingered Sedge	W8	NS		
<i>Carex elongata</i>	Elongated Sedge	W2,W5	NS		
<i>Cephalanthera rubra</i>	Red Helleborine		RDB cr	SCC	S8
<i>Clinopodium menthifolium</i>	Wood Calamint		RDB en	SCC	S8
<i>Corallorrhiza trifida</i>	Coralroot Orchid	W3	NS		
<i>Dryopteris cristata</i>	Crested Buckler-fern	W2,W4,W5	NTS		
<i>Epipactis atrorubens</i>	Dark-red Helleborine	W8, CG8, CG9, CG12, CG13	NS		
<i>Epipactis leptochila</i>	Narrow-lipped Helleborine		NS		
<i>Epipactis phyllanthes</i>	Green-flowered Helleborine		NS		
<i>Gentianella germanica</i>	Chiltern Gentian	CG2	NS		
<i>Gladiolus illyricus</i>	Wild Gladiolus		NTS	SCC	S8
<i>Helleborus foetidus</i>	Stinking Hellebore		NS		
<i>Himantoglossum hircinum</i>	Lizard Orchid	W21, CG7	RDB vu	SCC	S8
<i>Lathyrus palustris</i>	Marsh Pea	W24	NS		
<i>Leucojum aestivum</i>	Summer Snowflake		NTS		
<i>Leucojum vernum</i>	Spring Snowflake		RDB		
<i>Linnaea borealis</i>	Twinflower	W18,W19	NS	PS	
<i>Lithospermum purpureocaeruleum</i>	Purple Gromwell		NTS		
<i>Lobelia urens</i>	Heath Lobelia	M25	RDB vu	SCC	
<i>Lonicera xylosteum</i>	Fly Honeysuckle		RDB en		
<i>Lysimachia thyrsoiflora</i>	Tufted Loosestrife	W1,W3, M4	NS		
<i>Melampyrum cristatum</i>	Crested Cow-wheat		NS		
<i>Melampyrum pratense commutatum</i>	Common Cow-wheat		NS		
<i>Melittis melissophyllum</i>	Bastard Balm		NS		
<i>Meum athamanticum</i>	Spignel		NS		
<i>Orchis militaris</i>	Military Orchid	W21	RDB vu	SCC	S8
<i>Orchis purpurea</i>	Lady Orchid	W21	NS		
<i>Orchis simia</i>	Monkey Orchid	W21, CG2	RDB vu	SCC	S8
<i>Ornithogalum pyrenaicum</i>	Spiked Star-of-Bethlehem		NS		

The nature conservation value of scrub in Britain

Scientific name	English name	Occurrence in NVC types (where mentioned in NVC)	Status	BAP	S8
<i>Orobanche hederæ</i>	Ivy Broomrape		NS		
<i>Orobanche rapum-genistæ</i>	Greater Broomrape		NS	SCC	
<i>Peucedanum palustre</i>	Milk-parsley	W2,W5, M22, M24	NS		
<i>Physospermum cornubiense</i>	Bladderseed		RDB vu	SCC	
<i>Phyteuma spicatum</i>	Spiked Rampion		RDB vu	SCC	S8
<i>Polemonium caeruleum</i>	Jacob's-ladder	MG2	NTS	SCC	
<i>Potentilla crantzii</i>	Alpine Cinquefoil	W19, CG9-12, CG14, U15, U17	NS		
<i>Potentilla fruticosa</i>	Shrubby Cinquefoil	CG9	NTS	SCC	
<i>Pulmonaria longifolia</i>	Narrow-leaved Lungwort		NS		
<i>Pulmonaria obscura</i>	Suffolk Lungwort		RDB vu		
<i>Pyrola media</i>	Intermediate Wintergreen	W18,W19, H16	NS		
<i>Pyrola rotundifolia rotundifolia</i>	Round-leaved Wintergreen	W2,W3,W18, CG14, M9, U7	NS		
<i>Rosa agrestis</i>	Small-leaved Sweet-briar		NTS		
<i>Rumex aquaticus</i>	Scottish Dock		RDB vu		
<i>Salix arbuscula</i>	Mountain Willow	W20, CG14	NS		
<i>Salix lanata</i>	Woolly Willow	W20, U16, U17	RDB vu	PS	
<i>Salix lapponum</i>	Downy Willow	W20, CG14, H18, U15-17	NS		
<i>Salix myrsinites</i>	Whortle-leaved Willow	W20, CG14, U16, U17	NS		
<i>Salix reticulata</i>	Net-leaved Willow	W20, CG14, M11, U16, U17	NS		
<i>Salvia pratensis</i>	Meadow Clary	CG2	NS		S8
<i>Scrophularia scorodonia</i>	Balm-leaved Figwort		NS		
<i>Seseli libanotis</i>	Moon Carrot	W21, CG2	RDB vu		
<i>Silene nutans</i>	Nottingham Catchfly	W21, MG1, CG2	NS		
<i>Sorbus bristoliensis</i>	Broad-leaved Whitebeam		RDB en		
<i>Sorbus hibernica</i>	a Whitebeam		NS		
<i>Sorbus lancastriensis</i>	a Whitebeam		NTS		
<i>Sorbus rupicola</i>	a Whitebeam		NS		
<i>Sorbus wilmottiana</i>	a Whitebeam		RDB ce		
<i>Stachys germanica</i>	Downy Woundwort		RDB en		
<i>Thelypteris palustris</i>	Marsh Fern	W2,W5, M22, M24	NS		
<i>Vicia bithynica</i>	Bithynian Vetch		NS		
<i>Vicia lutea</i>	Yellow-vetch		NS		

Explanatory notes

NS Nationally Scarce species (occurring in 16 to 100 10 x 10 km squares in Great Britain, but not included in Red List)
 NTS Near threatened species (occurring in 15 or fewer 10 x 10 km squares in Great Britain, but not included in Red List)
 RDB cr Red List – critically endangered (IUCN 1994 criteria)
 RDB en Red List – endangered (IUCN 1994 criteria)
 RDB vu Red List – vulnerable (IUCN 1994 criteria)

PS BAP Priority Species in UK Biodiversity Action Plan
 SCC BAP Species of Conservation Concern in UK Biodiversity Action Plan

S8 Plant species on Schedule 8 of the Wildlife and Countryside Act 1981

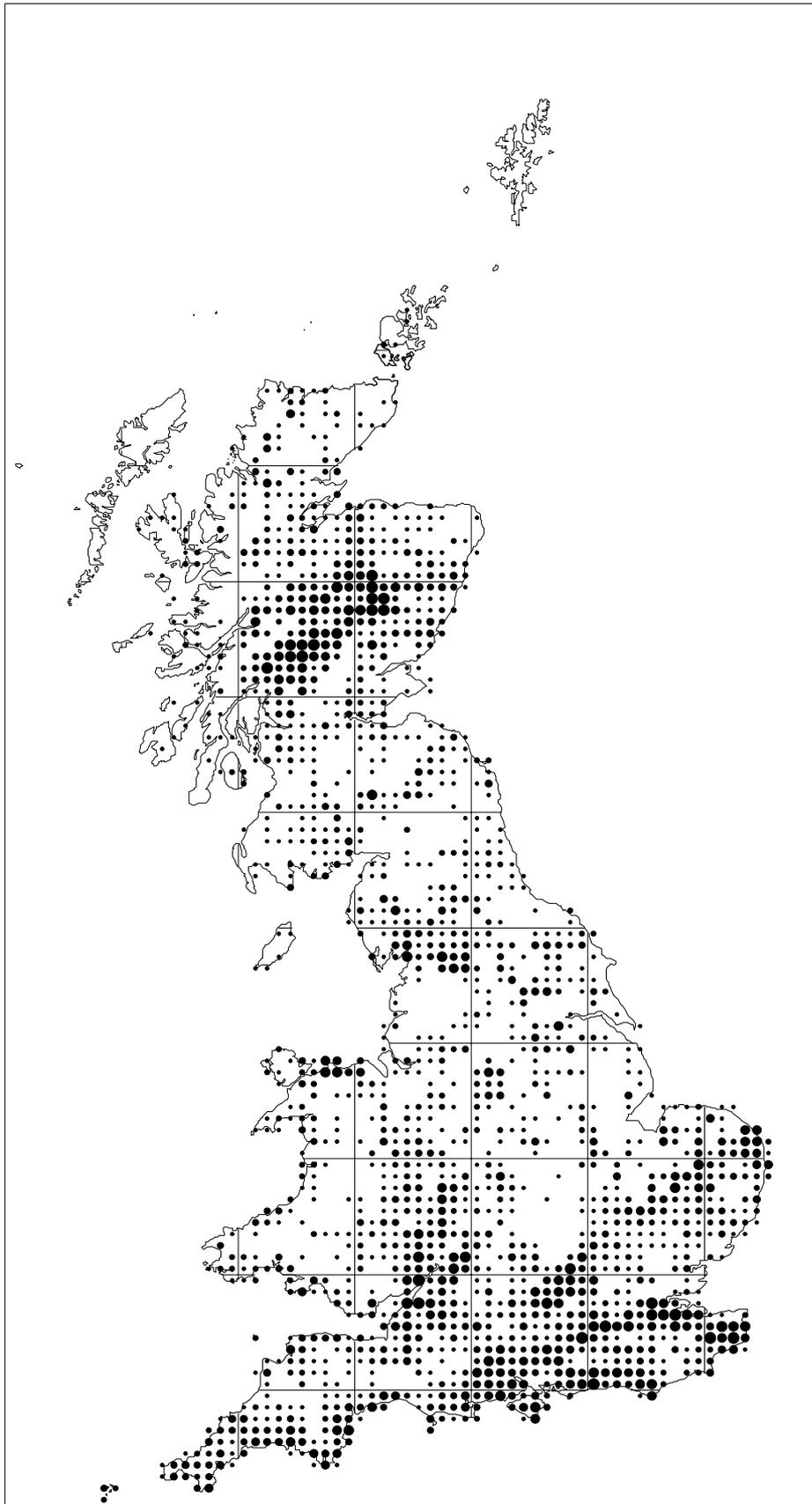


Figure 3.12 Species richness of Red Data Book and Nationally Scarce scrub plants. The smallest dots denote 10km squares in which 1 rare scrub species has been recorded; progressively larger symbols are used for additional species recorded, except that the largest symbol is used for squares with 9-12 species. Data are derived from the Biological Records Centre, all records are used.

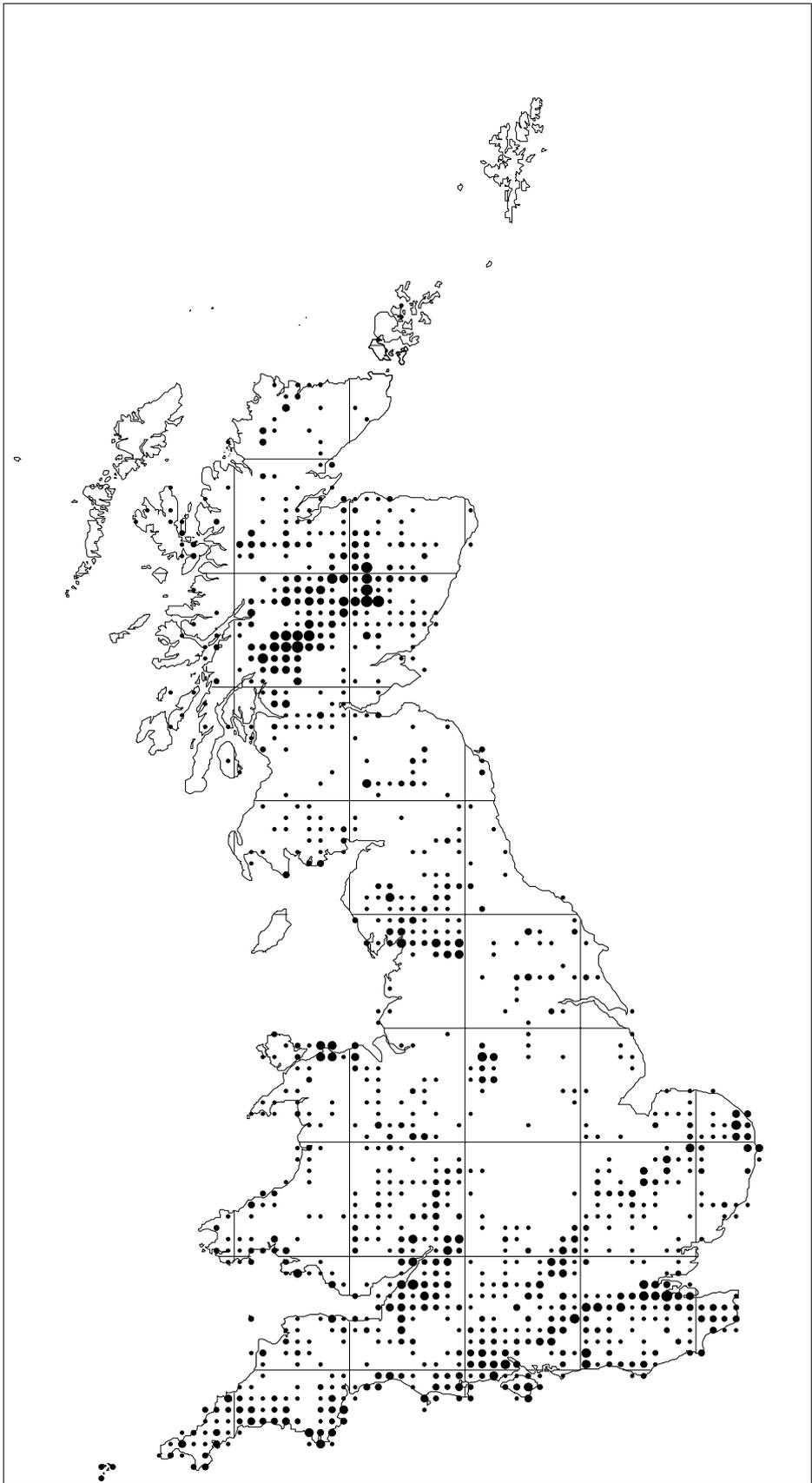


Figure 3.13 Species richness of Red Data Book and Nationally Scarce scrub plants. The smallest dots denote 10km squares in which 1 rare scrub species has been recorded; progressively larger symbols are used for additional species recorded, except that the largest symbol is used for squares with 9-10 species. Data are derived from the Biological Records Centre, only post 1970 records are used.

3.2.2 Lower plants

Some woody scrub species, such as elder *Sambucus nigra*, can be an important substrate for epiphytic lower plants. Coastal scrub can be particularly valuable for lichens, whilst in Scotland, hazel stands support important lichen communities including several species endemic to the British Isles. The larger, older stems in a hazel stool are most important, suggesting that apart from climate, ecological continuity is of key importance to the maintenance of these lichen communities. Currently, three lichen species associated with scrub have Species Action Plans in the UK Biodiversity Action Plan, namely *Graphina pauciloculata*, *Pseudocyphellaria norvegica* and *Teloschistes chrysophthalmus*. Scrub also forms a sheltered habitat favoured by bryophytes. In East Anglia wet scrub woodland communities were valued for their assemblages of *Sphagnum* spp..

A study of the development of mycoflora of three juniper scrubs in The Netherlands and Germany over the period from 1964-1991 (Vries & Arnold 1994) showed an increase with scrub age of nitrophytic litter decomposers and a corresponding decline of species associated with weakly acidic grasslands. Lignicolous and ectomycorrhizal fungi increased as the scrub became progressively invaded by other coniferous and broadleaved trees. Some rare fungi were found to be associated with the scrub and one species had not been reported previously from Germany.

3.2.3 Birds

3.2.3.1 Breeding bird communities – an overview

Scrub is used by an extremely wide range of bird species. Almost all respondents to the questionnaire thought scrub important for birds. Several distinctive assemblages of breeding birds in scrub habitats can be identified based on existing knowledge. These are summarised in Table 3.3. The diversity of bird life in scrub is partly accounted for by the fact that it embraces a wide range of vegetation structures. In the early stages of succession, lowland scrub can support several breeding birds such as skylark *Alauda arvensis*, meadow pipit *Anthus pratensis* and whinchat *Saxicola rubetra* that are essentially associated with open grassland or heathland. In its later stages of development, scrub supports many characteristic woodland birds such as blackbird *Turdus merula*, song thrush *Turdus philomelos*, robin *Erithacus rubecula* and chaffinch *Fringilla coelebs*. Between these two extremes, more specialised scrub bird communities are found in the lowlands, typified by high densities of breeding warblers, especially willow warbler *Phylloscopus trochilus*, whitethroat *Sylvia communis*, garden warbler *Sylvia borin*, lesser whitethroat *Sylvia curruca* and blackcap *Sylvia atricapilla* (Fuller 1995). Similar lowland bird communities, often with exceptionally high densities of breeding warblers, are only found in middle-aged coppice (e.g. Fuller & Henderson 1992).

Often scrub exists as a mosaic with other habitats, including grassland, heathland or woodland. In such places the diversity of breeding birds can be extremely high because a wide range of niches and habitat structures can be present. The effect of scrub structure on birds is considered in greater detail in sections 4.2.2 and 4.2.3.

The diversity of breeding bird life in scrub is illustrated by an analysis of breeding bird censuses undertaken on 39 scrub sites distributed throughout Britain but concentrated mainly in the south (R.J. Fuller, S. Gillings & S.J. Gough, unpublished data). These

sites were all censused as part of the BTO's Common Birds Census and they consisted either of continuous scrub or mosaics of dense scrub intimately mixed with patches of grass, bracken or ericaceous shrubs. In all cases, scrub cover exceeded 50%. A total of 89 breeding bird species was recorded on these sites and the species were extremely diverse in body size, diet, nest site usage and habitat needs. The most abundant species of birds breeding at these sites are shown in Table 3.4.

Willow warbler, blackbird, dunnock *Prunella modularis*, wren *Troglodytes troglodytes*, yellowhammer *Emberiza citrinella* and linnet *Carduelis cannabina* are consistently among the most abundant species breeding in scrub habitats in Britain. Hole-nesting species are generally scarce breeding species in scrub, but Table 3.4 shows that blue tit *Parus caeruleus* is generally the most common hole-nester. There is, however, much variation in the composition of scrub bird communities depending on the mosaic of vegetation types that are present, the successional stage and geographical location. Some species that do not feature in Table 3.4 may, in fact, be highly characteristic of certain restricted forms of scrub. Examples include stonechat *Saxicola torquata* in western gorse scrub and sedge warbler *Acrocephalus schoenobaenus* in wet scrub (Table 4.2.2.1).

3.2.3.2 Use of scrub by scarce and declining breeding birds

Scrub is an important habitat for several breeding bird species that are rare, local or in serious decline in Britain. Cetti's warbler *Cettia cetti* is closely associated with marshy scrub or willow carr (Wotton *et al.* 1998). The extremely rare marsh warbler *Acrocephalus palustris* will also breed in wet bushy habitats. Dartford warbler *Sylvia undata* is a species of lowland heathland that is largely dependent on mixtures of heather and gorse. The most productive territories are ones that have much gorse, though the preferred nest site is in heather (Bibby 1979a). Much of the food is collected from gorse (Bibby 1979b).

Two other heathland birds – nightjar *Caprimulgus europaeus* and woodlark *Lullula arborea* – will also use areas of open or scattered scrub, though they do not depend on it as strongly as the Dartford warbler. Both species appear to require some bushes or trees as songposts and heathland-nesting nightjars may even show a preference for nesting in areas with scattered birch and pine scrub (Berry 1979). In both cases, however, encroachment of trees and bushes rapidly results in site abandonment, although nightjar will tolerate a greater level of scrub and tree cover than will woodlark. Hedgerows or scrub are essential components of the territory of the curl bunting *Emberiza cirlus* (Sitters 1985).

Scrub habitats appear to be of increasing importance to the declining English population of nightingales *Luscinia megarhynchos* (Fuller *et al.* 1999). The 1999 BTO survey of the species shows that more territories are now associated with scrub habitats than with coppice (Wilson 2000). Nightingales require dense thickets which are also favoured by species such as garden warbler and blackcap. In southern England (as far north as Lincolnshire and Nottinghamshire) scrub was managed by a large number of questionnaire respondents for nightingales. Scrub is also important for another declining lowland bird species, the turtle dove *Streptopelia turtur*. In this case, closed-canopy scrub is among one of its main nesting habitats, though the birds obtain much of their food (seeds) from adjacent open habitats.

The nature conservation value of scrub in Britain

Table 3.3 Scrub habitats supporting particularly distinctive assemblages of breeding birds in Britain.

Northern upland scrub Principally birch *Betula* and juniper *Juniperus* scrub which is relatively poor in bird species and strongly dominated by willow warbler *Phylloscopus trochilus* (Gillings & Fuller 1998, Gillings *et al.* 1998).

Western upland scrub Upland slopes in Wales, the Shropshire Hills and south-west England often carry mixtures of hawthorn *Crataegus monogyna* scrub and bracken *Pteridium aquilinum* (termed *ffridd* in Wales) and sometimes gorse *Ulex* which can be exceptionally rich in chats including whinchat *Saxicola rubetra*, common stonechat *Saxicola torquata* and common redstart *Phoenicurus phoenicurus*.

Lowland heathland scrub Gorse *Ulex* mixed with rank heather *Calluna vulgaris* supports a species-poor assemblage including Dartford warbler *Sylvia undata* and common stonechat (*Saxicola torquata*) (Bibby 1978).

Lowland hawthorn Crataegus monogyna and mixed scrub The bird communities are typified by high densities of warblers in the canopy-closure phase and by yellowhammers *Emberiza citrinella*, linnets *Carduelis cannabina* and common whitethroats *Sylvia communis* in the earlier stages of scrub growth.

Lowland Blackthorn Prunus spinosa scrub Dense blackthorn *Prunus spinosa* appears to be a preferred habitat of nightingales (Rufous Nightingale *Luscinia megarhynchos*) in southern England, though it also uses other scrub types and coppiced woodland. In other respects the bird assemblage resembles that of hawthorn *Crataegus monogyna* scrub.

Wet scrub Sedge warbler (*Acrocephalus schoenobaenus*), reed bunting (*Emberiza schoeniclus*) and, far more rarely, Cetti's (*Cettia cetti*) and marsh warblers (*Acrocephalus palustris*) will use scrub often in conjunction with adjacent marsh or fen vegetation, including reedbeds.

Coastal dune scrub Sea-buckthorn *Hippophae rhamnoides* scrub, often mixed with hawthorn *Crataegus monogyna* and elder *Sambucus nigra*, can support high overall densities of birds including high densities of common whitethroats *Sylvia communis*, linnets *Carduelis cannabina* and common redpolls *Carduelis flammea* (Williamson 1967, Morgan 1978). Densities of common whitethroats *Sylvia communis* in particular can be exceptionally high (Boddy 1992).

Table 3.4 The 10 species with the highest mean territory densities (territory ha⁻¹) in an analysis of 39 BTO Common Birds Census scrub sites. Not all sites were censused in each time period.

Rank	1966-68 (n=15)		1973-75 (n=15)		1980-82 (n=28)	
	Species	Density	Species	Density	Species	Density
1	Willow warbler <i>Phylloscopus trochilus</i>	0.90	Wren <i>Troglodytes troglodytes</i>	1.03	Willow warbler <i>Phylloscopus trochilus</i>	0.87
2	Linnet <i>Carduelis cannabina</i>	0.88	Willow warbler <i>Phylloscopus trochilus</i>	1.02	Blackbird <i>Turdus merula</i>	0.59
3	Blackbird <i>Turdus merula</i>	0.79	Blackbird <i>Turdus merula</i>	0.92	Dunnock Hedge Accentor, <i>Prunella modularis</i>	0.56
4	Dunnock HedgeAccentor, <i>Prunella modularis</i>	0.75	Dunnock HedgeAccentor, <i>Prunella modularis</i>	0.83	Wren <i>Troglodytes troglodytes</i>	0.49
5	Common Whitethroat <i>Sylvia communis</i>	0.72	Linnet <i>Carduelis cannabina</i>	0.68	Robin <i>Erithacus rubecula</i>	0.46
6	Yellowhammer <i>Emberiza citrinella</i>	0.65	Robin <i>Erithacus rubecula</i>	0.55	Chaffinch <i>Fringilla coelebs</i>	0.40
7	Sky Lark <i>Alauda arvensis</i>	0.53	Yellowhammer <i>Emberiza citrinella</i>	0.45	Yellowhammer <i>Emberiza citrinella</i>	0.39
8	Meadow Pipit <i>Anthus pratensis</i>	0.44	Chaffinch <i>Fringilla coelebs</i>	0.40	Linnet <i>Carduelis cannabina</i>	0.31
9	Song thrush <i>Turdus philomelos</i>	0.38	Blue tit <i>Parus caeruleus</i>	0.34	Blue tit <i>Parus caeruleus</i>	0.24
10	Wren <i>Troglodytes troglodytes</i>	0.32	Song thrush <i>Turdus philomelos</i>	0.32	Sky lark <i>Alauda arvensis</i>	0.23

In the uplands, scrub is important to another declining species, the black grouse *Tetrao tetrix*. Birch, willow and juniper scrub can support this species which lives at the interface of open moorland and woodland (Parr & Watson 1988). In Scotland, respondents referred to the management of willow and juniper scrub for this species.

Capercaillie *Tetrao urogallus* may also occasionally use upland scrub but the species is principally associated with mature stands of Scots pine.

Finally, the red-backed shrike *Lanius collurio*, though virtually extinct as a breeding bird in Britain, was once strongly dependent on thorny scrub of various kinds. If the shrike were to make a recovery it would presumably reoccupy these habitats. In summary, scrub is an extremely important habitat for several species in Britain in the sense that a high proportion of individuals depend on it. These species include black grouse, turtle dove, nightingale, whinchat, stonechat, Cetti's warbler, Dartford warbler and circl bunting.

Several priority Biodiversity Action Plan bird species make use of scrub as major breeding habitat: marsh warbler, nightjar, turtle dove, linnet, circl bunting, red-backed shrike, bullfinch *Pyrrhula pyrrhula*, black grouse and song thrush. A full list of Biodiversity Action Plan bird species for which scrub is a major habitat appears in Table 3.5

3.2.3.3 Non-breeding uses of scrub by birds

Most research on birds in scrub has been undertaken in the breeding season. Nonetheless, scrub is important as a roosting habitat and as a source of food for migrant and wintering birds and for birds breeding in adjacent habitats. Scrub also provides shelter for migrating and wintering birds.

Long-eared owls *Asio otus* depend heavily on scrub for winter roosting (R. Williams pers comm.). More commonly, however, large flocks of starlings *Sturnus vulgaris*, thrushes, finches and buntings roost in scrub of various kinds, though there has never been a detailed study of their roost requirements. The importance of scrub as a roost for birds was illustrated by a study at Castor Hanglands National Nature Reserve in which winter counts of birds were made in grassland, rank grass and low scrub, dense scrub and deciduous woodland (Gough 1999). During the day, similar numbers of birds were counted in dense scrub and woodland. In late afternoon, however, there were huge influxes of roosting birds into the dense scrub and counts at that time were approximately five times as great as in the woodland. The main species roosting in the scrub were fieldfare *Turdus pilaris*, redwing *Turdus iliacus*, blackbird, starling, greenfinch *Carduelis chloris* and yellowhammer.

Provision of food by berried shrubs is important to winter visitors and passage migrants; this was frequently mentioned by questionnaire respondents, the value of sea buckthorn being highlighted. For accounts of use of scrub by migrant birds see Boddy (1991) and Edgar (1986). In fact, a wide range of berry-bearing shrubs is exploited by birds in a mutualistic relationship between plant and bird. The use of shrubs as a source of food by berry-feeding birds is described in greater detail in chapter 4. Hawthorn is generally less abundant on mainland Europe than in Britain where its berries provide a staple food for flocks of migrant thrushes in autumn and winter (Snow & Snow 1988). British hedgerows and scrub dominated by hawthorn can therefore be regarded as a resource of international significance for species such as fieldfare and redwing.

A final important point about the use of scrub by birds is that it often forms a key resource in a landscape context. For many species, scrub may not provide all the resources required, either spatially or in terms of the annual life cycle. Nonetheless, scrub can provide essential resources at certain times which may influence productivity and survival. One example is the wintering thrushes, starlings, finches and buntings that feed on farmland but roost in scrub. These roosts themselves become valuable food resources for predatory birds such as sparrowhawk *Accipiter nisus* and tawny owl *Strix aluco*. Another example, is provided by upland scrub that can

provide food resources in early spring for merlins *Falco columbarius* Bibby (1986). It has been suggested that the provision of more scrub in upland areas would benefit birds of prey such as merlin, hen harrier *Circus cyaneus* and short-eared owl *Asio flammeus* because there would be an increase in prey in the form of small birds and mammals (Usher & Thompson 1993).

Table 3.5 Biodiversity Action Plan bird species for which scrub can form a particularly important habitat. In each case some indication of the principal use of scrub is given. The order of species follows the British Ornithologists' Union British List.

Priority Biodiversity Action Plan species

Black grouse	<i>Tetrao tetrix</i>	year-round habitat (uplands)
Turtle dove	<i>Streptopelia turtur</i>	nesting habitat (dense scrub)
Nightjar	<i>Caprimulgus europaeus</i>	breeding habitat (open scrub)
Woodlark	<i>Lullula arborea</i>	breeding habitat (open scrub)
Song thrush	<i>Turdus philomelos</i>	year-round habitat
Marsh warbler	<i>Acrocephalus palustris</i>	breeding habitat (wet scrub)
Red-backed shrike	<i>Lanius collurio</i>	potential breeding habitat
Tree sparrow	<i>Passer montanus</i>	roost habitat
Linnet	<i>Carduelis cannabina</i>	nesting and roost habitat
Bullfinch	<i>Pyrrhula pyrrhula</i>	year-round habitat
Cirl bunting	<i>Emberiza cirlus</i>	nesting and roost habitat
Reed bunting	<i>Emberiza schoeniclus</i>	nesting (wet scrub) and roost habitat
Corn bunting	<i>Miliaria calandra</i>	roost habitat

Species of Conservation Concern

Merlin	<i>Falco columbarius</i>	feeding habitat in spring, possible roost habitat
Long-eared owl	<i>Asio otus</i>	nesting and roost habitat
Tree pipit	<i>Anthus trivialis</i>	breeding habitat (open scrub)
Duncock	<i>Prunella modularis</i>	mainly breeding habitat
Nightingale	<i>Luscinia megarhynchos</i>	breeding habitat
Whinchat	<i>Saxicola rubetra</i>	breeding habitat (mainly open upland scrub)
Stonechat	<i>Saxicola torquata</i>	breeding and wintering habitat (open scrub)
Fieldfare	<i>Turdus pilaris</i>	winter feeding and roosting habitat
Redwing	<i>Turdus iliacus</i>	winter feeding and roosting habitat
Cetti's warbler	<i>Cettia cetti</i>	year-round habitat (wet scrub)
Grasshopper warbler	<i>Locustella naevia</i>	breeding habitat (open scrub)
Sedge warbler	<i>Acrocephalus schoenobaenus</i>	breeding habitat (wet scrub)
Dartford warbler	<i>Sylvia undata</i>	year-round habitat (gorse)
Lesser Whitethroat	<i>Sylvia curruca</i>	breeding habitat
Garden warbler	<i>Sylvia borin</i>	breeding habitat
Blackcap	<i>Sylvia atricapilla</i>	breeding habitat
Chiffchaff	<i>Phylloscopus collybita</i>	winter habitat, especially wet scrub
Willow warbler	<i>Phylloscopus trochilus</i>	breeding habitat
Goldcrest	<i>Regulus regulus</i>	breeding and, especially, wintering habitat
Firecrest	<i>Regulus ignicapillus</i>	winter habitat, mainly in western Britain
Willow tit	<i>Parus montanus</i>	year-round habitat
Greenfinch	<i>Carduelis chloris</i>	roost habitat
Goldfinch	<i>Carduelis carduelis</i>	roost habitat
Redpoll	<i>Carduelis flammea</i>	nesting and roost habitat
Hawfinch	<i>Coccothraustes coccothraustes</i>	winter feeding habitat
Yellowhammer	<i>Emberiza citrinella</i>	breeding and roost habitat

3.2.4 Invertebrates

The dominating woody plants of scrub are the food-plants of very many species of phytophagous insects and mites (Table 3.6). There are also numerous other insect species feeding upon the lichens, algae and fungi associated with the bark and wood of shrubs and trees. Many of these insects are at the base of complex food webs, which include parasitic and hyperparasitic insects, and predatory insects, mites and spiders (Duffey *et al.* 1974, Shaw 1984). All these invertebrates provide food for larger animals, particularly insectivorous birds.

Saproxyllic species make a major contribution to the invertebrate component of scrub habitats. Most leave the decomposing wood habitat for some phase of their life history (Speight 1989), often when the adults are dispersing in the spring and early summer (Kirby 1992). Many Coleoptera and Diptera that breed in dead wood are thought to be dependent on other habitats as adults (Stubbs 1972). Nectar (easily assimilated energy) and pollen (protein for egg laying) from flowering plants are thought to be the key needs of saproxyllic insects with requirements for other habitats (Warren & Key 1989). The proximity of dead wood to sources of nectar and pollen, particularly from Umbelliferae, Compositae and hawthorn (Warren & Key 1989) is likely to be best satisfied within a diverse mosaic of habitat types and structures at the grassland/scrub/woodland interfaces. For example, scrub species such as hawthorn and blackthorn in the vicinity of ancient trees may provide nectaring sources for tree-living saproxyllic species (Sisitka 1996). Open space may also be important for flight lines to nectaring sites (Key & Ball 1993, Key 1996), suggesting dense scrub or woodland may disadvantage some species (Stubbs 1972). Hawthorn is thought to be the most important early nectar source (Stubbs 1972, Kirby 1992, Key 1996), and many species including saproxyllic species appear to have life-cycles adapted so that the peak of adult emergence coincides with the peak of hawthorn blossom (Key 1996). Other scrub species used for nectaring by saproxyllic species include holly, guelder-rose and bramble, in addition to broad-leaved herbs often found in an open scrub/grassland/woodland mosaic, such as hogweed, angelica, ragwort and thistle (Alexander *et al.* 1996, Alexander 1999). The deadwood of many scrub species is used, for example, hawthorn is used by wood-boring Anobiidae beetles, and Buprestidae beetles (jewel beetles) such as *Agrilus sinatus*. Larvae of the Red Data Book (Endangered) Buprestidae *Anthaxia nitidula* is found only beneath the bark of blackthorn and some other woody Rosaceae (Shirt 1987).

Some saproxyllic species are dependent on flowers, not for the nectar or pollen resources, but as a site for predation of the insects feeding on these structures (Key 1996, Warren & Key 1989, Key & Ball 1993).

The total number of species of phytophagous insect/mites feeding on 31 scrub woody plant genera was 2219 (Table 3.6). This is nearly a third of the total phytophagous species in Britain. Total numbers of species on plants can be related to the size of the plants (trees>shrubs>perennial herbs>annuals) and to their abundance, geographical spread and the length of time the plant species has been present since the last glaciation (Lawton & Schroder 1977, Strong *et al.* 1984, Leather 1986).

Of the phytophagous orders Lepidoptera have the most species on scrub woody plants, followed by Coleoptera, Hemiptera,

Hymenoptera, Diptera, Acari and Thysanoptera. Orthoptera are almost all polyphagous, and bush crickets are the most likely to be recorded. Phasmidae (stick insects) have been introduced and are recorded in a few places in the West Country.

Taxonomically isolated shrub genera having few or no other species or genera in their plant family often have low numbers of associated insects e.g. hollies *Ilex*, box and yew. These three species are also evergreen, with tough resistant leaves and have high levels of deterrent secondary biochemicals to which few insects have been able to adapt (Daniewski *et al.* 1998.)

Of the eight genera with <30 insect/species in Table 3.6, five are introduced plant genera (Yela & Lawton 1997). Oligophagous insects, found in the original geographical range of introduced plants have not colonised Britain for a variety of reasons, but when they do appear, they often spread rapidly e.g. on firethorns *Pyracantha* (Nash *et al.* 1995). British native insects will spread to introduced plants, if the plants have close taxonomic relatives, but some insect species may not adapt quickly. Therefore it is expected that the total numbers of insects/mites will rise slowly on introduced plants.

3.2.4.1 Specificity of insects to the shrub genus

The majority of insects are specific to plant family. In the ITE Phytophagous Insect Data Bank (PIDB) records 76% are family specific while a further 10% occur on two families only (Ward & Spalding 1993). Insects are less specific to genera and in this scrub data 34% fed only on the genus (760 species out of 2219 insects/mites). The numbers specific to plant species (i.e. monophagous) are not available, but are known to be lower than on genera, and with more uncertainties. Recorders do not include all hosts of polyphagous insects, while rare plants are less well studied entomologically than common plants (Ward 1988). Table 3.7 shows the total numbers specific to the genus for the 31 shrubs of Table 3.6. Most of the genera with many insects in total also have more specific species and vice versa (Figure 3.14). Some genera deviate more than others from this general pattern, and are considered briefly below.

Juniper has the highest proportion of generically specific species (41%) compared to the total number of species that have been found feeding upon it. Taxonomic isolation is one factor involved here, as plant species that are monotypic to a family and genus often have a higher proportion of specific invertebrate species. Juniper is our only native representative of the Cupressaceae. Additionally juniper has a wide range, with arctic-alpine phytophagous insects in Scotland and species with Mediterranean distribution in southern England.

There are higher percentages of specific species on maples *Acer* (31%) and willows *Salix* (29%) and roses *Rosa*. This is partly because of the strong representation of families of insects with many oligophagous insects. These are mainly insects which feed endophytically e.g. gall midges, gall mites, micro-moth leaf-miners, and also aphids which are often specific (Ward & Spalding 1993).

Again, the wide geographical spread of the hosts, particularly of *Salix* (Willows) and *Rosa* (Roses) is important.

Introduced plant genera all appear in the second half of Table 3.7, and have few generically specific insects/mites. No specific species have been recorded so far on butterfly-bushes *Buddleja*, aromatic wintergreens *Gaultheria* and snowberries *Symphoricarpos*.

The nature conservation value of scrub in the UK

Table 3.6 Number of insect species feeding on woody scrub plant genera.

Scrub genera	Total	Lepidoptera	Hemiptera	Coleoptera	Hymenoptera	Diptera	Acari	Thysanoptera	Orthoptera	Phasmida	Dermaptera
<i>Salix</i> (Willows)	752	296	124	160	106	46	15	5			
<i>Betula</i> (Birches)	521	262	68	115	52	10	7	7			
<i>Prunus</i> * (Cherries)	384	214	62	63	19	9	12	4	1		
<i>Crataegus</i> * (Hawthorns)	356	198	55	68	17	7	9	2			
<i>Alnus</i> (Alders)	283	92	67	78	29	3	10	4			
<i>Corylus</i> (Hazels)	253	91	54	70	18	6	11	3			
<i>Rubus</i> * (Brambles)	237	114	39	29	31	10	8	4	1		1
<i>Rosa</i> * (Roses)	215	81	45	29	38	12	4	4			2
<i>Acer</i> (Maples)	193	71	50	42	5	5	18		1		
<i>Sorbus</i> * (Whitebeams)	160	62	31	38	19	3	7				
<i>Sarothamnus</i> (Brooms)	124	53	29	24	2	12	3	1			
<i>Ulex</i> (Gorses)	71	31	11	17		4	3	5			
<i>Ligustrum</i> (Privets)	66	42	12	5	2	3	1	1			
<i>Myrica</i> (Bog-myrtles)	66	48	14	4							
<i>Juniperus</i> (Junipers)	63	23	20	5	3	5	5	2			
<i>Cornus</i> (Dogwoods)	55	25	17	7	1	2	2	1			
<i>Rhamnus</i> (Buckthorns)	46	21	15	4	1	3	2				
<i>Buddleja</i> # (Butterfly-bushes)	44	35	3	4		1	1				
<i>Viburnum</i> (Viburnums)	44	14	17	5	3	3	2				
<i>Ilex</i> (Hollies)	36	9	16	10		1					
<i>Sambucus</i> (Elders)	36	9	6	8	2	6	2	3			
<i>Clematis</i> (Traveller's-joys)	35	22	4	2		3	1	2			1
<i>Euonymus</i> (Spindles)	33	13	17	2			1				
<i>Frangula</i> (Alder Buckthorn)	28	20	6	1		1					
<i>Hippophae</i> # (Sea-buckthorn)	28	15	7	5			1				
<i>Rhododendron</i> # (Rhododendrons)	27	8	16	1		1	1				
<i>Taxus</i> (Yew)	26	10	8	3		1	4				
<i>Symphoricarpos</i> # (Snowberries)	25	12	2	2	4	5					
<i>Buxus</i> #? (Box)	22	1	18			1	2				
<i>Tamarix</i> # (Tamarisks)	14	5	7			1	1				
<i>Gaultheria</i> # (Aromatic Wintergreens)	3		3								
TOTAL	2219	864	455	356	247	154	109	29	2	2	1

* Genera belonging to the Rosaceae # Genera of introduced plant species (*Buxus* [Box] probably native Staples 1970)

Table 3.7 Number of insect species *only* feeding on woody scrub plant genera (annotation see Table 3.6)

Scrub genera	Total	Lepidoptera	Hemiptera	Hymenoptera	Diptera	Acari	Coleoptera	Thysanoptera	Dermaptera	Orthoptera	Phasmida
<i>Salix</i> (Willows)	217	40	54	59	37	7	16	4			
<i>Betula</i> (Birches)	112	50	19	21	9	3	8	2			
<i>Acer</i> (Maples)	60	20	17	3	5	13	2				
<i>Rosa</i> * (Roses)	44	15	6	18	4	1					
<i>Prunus</i> * (Cherries)	43	21	5	6	4	6	1				
<i>Alnus</i> (Alders)	40	13	7	8	3	4	4	1			
<i>Rubus</i> * (Brambles)	32	9	5	9	4	5					
<i>Crataegus</i> * (Hawthorns)	29	8	7	5	4	2	3				
<i>Juniperus</i> (Junipers)	26	12	3	2	5	3		1			
<i>Sarothamnus</i> (Brooms)	26	5	7		10	2	1	1			
<i>Corylus</i> (Hazels)	22	4	6	1	4	5	2				
<i>Ulex</i> (Gorses)	16	5	1		3	2	3	2			
<i>Sorbus</i> * (Whitebeams)	14	2	2	4	2	4					
<i>Clematis</i> (Traveller's-joys)	10	4	1		3	1	1				
<i>Rhamnus</i> (Buckthorns)	10	2	5		1	2					
<i>Rhododendron</i> # (Rhododendrons)	8	2	4		1	1					
<i>Cornus</i> (Dogwoods)	7	2	1	1	2	1					
<i>Viburnum</i> (Viburnums)	7	2	3		1	1					
<i>Euonymus</i> (Spindles)	6	6									
<i>Hippophae</i> # (Sea-buckthorn)	5	2	2			1					
<i>Buxus</i> #? (Box)	5		2		1	2					
<i>Ligustrum</i> (Privets)	4	1	1		2						
<i>Myrica</i> (Bog-myrtles)	4	2	2								
<i>Sambucus</i> (Elders)	4			1	1	1		1			
<i>Tamarix</i> # (Tamarisks)	4	1	1		1	1					
<i>Frangula</i> (Alder Buckthorn)	2	1	1								
<i>Ilex</i> (Hollies)	2		1		1						
<i>Taxus</i> (Yew)	2		1			1					
<i>Buddleja</i> # (Butterfly-bushes)	0										
<i>Gaultheria</i> # (Aromatic Wintergreens)	0										
<i>Symphoricarpos</i> # (Snowberries)	0										
Total	760	229	164	138	108	68	41	12	0	0	0

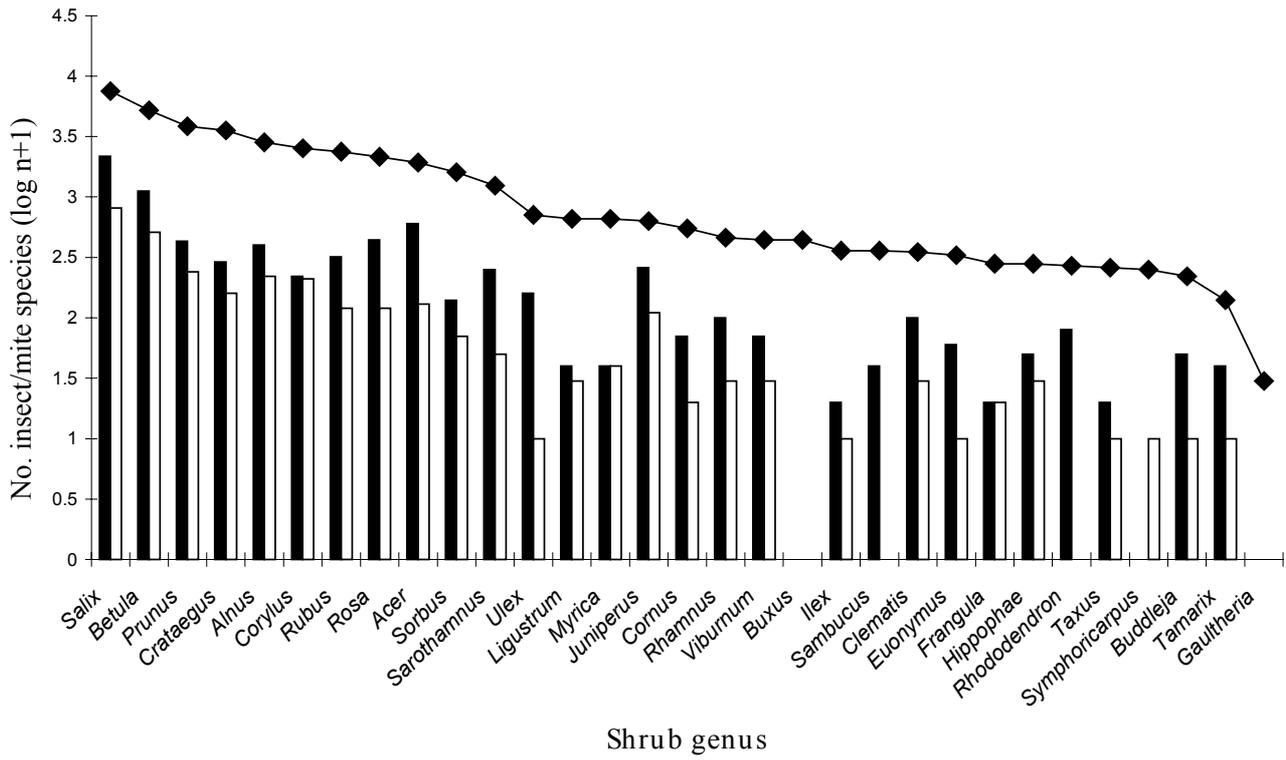


Fig. 3.14 Total numbers of insect and mite species (line), with numbers specific to genus (black bars) and Red Data Book species (white bars), arranged in order of total numbers on the shrub genera of Table 3.6 (Scale log +1).

3. Distribution and conservation value

Table 3.8 Number of Red Data Book (RDB) and Biodiversity Action Plan (BAP) insect species per woody scrub plant genera.

Scrub genera	RDB species:											BAP species:			
	Total RDB	RDB Endangered	RDB Endangered (proposed)	RDB Vulnerable	RDB Vulnerable (proposed)	RDB Rare	RDB Rare (status uncertain)	RDB Rare (proposed)	RDB Out of danger	Extinct (no RDB status)	Extinct probably (no RDB status)	RDB Insufficiently known (proposed)	Total BAP	BAP1	BAP2
	1	1p	2	2p	3	3*	3p	4	Ex	Exp	Kp		1	2	
<i>Salix</i> (Willows)	81	15	11	7	1	20	2	23	1		1	20	19	1	
<i>Betula</i> (Birches)	51	8	5	7	2	16		12	1			15	14	1	
<i>Prunus</i> (Cherries)	24	4	7	2	1	5		3	1	1		3	3		
<i>Alnus</i> (Alders)	22	4	1	5	1	9		2				7	6	1	
<i>Corylus</i> (Hazels)	21	5	3	5	1	5		2				6	6		
<i>Crataegus</i> (Hawthorns)	16	4	4	4		4						2	2		
<i>Acer</i> (Maples)	13	2	2	1	1	3		2		2		1	1		
<i>Rosa</i> (Roses)	12	1		2	1	2		5			1	1	1		
<i>Rubus</i> (Brambles)	12		1	2	1	3		3	1	1		0			
<i>Juniperus</i> (Junipers)	11	3	2		2		2	2				0			
<i>Sorbus</i> (Whitebeams)	7	1	1	3		1		1				0			
<i>Sarothamnus</i> (Brooms)	5		2			2		1				2	2		
<i>Myrica</i> (Bog-myrtles)	4	1	1			2						1	1		
<i>Clematis</i> (Traveller's-joys)	3			2		1						0			
<i>Hippophae</i> (Sea-buckthorn)	3		2		1							0			
<i>Ligustrum</i> (Privets)	3			1		1			1			1	1		
<i>Rhamnus</i> (Buckthorns)	3	1				2						0			
<i>Viburnum</i> (Viburnums)	3					1			1	1		0			
<i>Cornus</i> (Dogwoods)	2		2									0			
<i>Frangula</i> (Alder Buckthorn)	2					1			1			0			
<i>Buxus</i> (Box)	1	1										0			
<i>Euonymus</i> (Spindles)	1				1							0			
<i>Ilex</i> (Hollies)	1					1						0			
<i>Symphoricarpos</i> (Snowberries)	1		1									1	1		
<i>Taxus</i> (Yew)	1	1										0			
<i>Tamarix</i> (Tamarisks)	1			1								0			
<i>Buddleja</i> (Butterfly-bushes)	0											0			
<i>Gaultheria</i> (Aromatic Wintergreens)	0											0			
<i>Rhododendron</i> (Rhododendrons)	0											0			
<i>Sambucus</i> (Elders)	0											1	1		
<i>Ulex</i> (Gorses)	0											1	1		

The nature conservation value of scrub in the UK

3.2.4.2 Red Data Book (RDB) and Biodiversity Action Plan (BAP) Insect species

All the categories of RDB and BAP species among the 2219 phytophagous species recorded in the PIDB on 31 genera of scrub woody plants are listed in Table 3.8. In all there were 206 species, 9% of the total scrub insects/mites. 83 of these 206 insects (40%) are recorded only on one genus of plant. For the different orders, 92 species were Lepidoptera, many being macro-moths, while there were 55 Coleoptera, 45 Hymenoptera, 13 Hemiptera, only one Diptera and no Acarina or Thysanoptera.

Like the generically specific species, the numbers of RDB species are correlated with the overall total insects *Juniperus* has the highest percentage of RDB species compared to its total fauna (17%). It is therefore particularly important to conserve this plant with its fauna, especially as juniper is known to be declining in many lowland areas (Ward 1973, Borders Forest Trust 1997, Clifton *et al.* 1997). The

lowlands of southern England have insects of Mediterranean distribution, but there are other RDB and restricted distribution species in montane areas of Scotland, where there may be climate change in the future. For example, the Kentish glory moth *Endromia versicolora* requires young birch saplings up to approximately 2 m high for egg laying (Barbour & Young 1993).

Willow, birch and sea-buckthorn also have high proportions of RDB species. The figures for willow, divided into those species occurring on lowland and montane willow species, are shown in Table 3.9.

Gorse is interesting in having no scheduled rare species at all, although there are 71 phytophagous species recorded. Butterfly-bush also has no RDB species, out of 44 insects recorded, and has no generically restricted species.

Table 3.9 Numbers of insects recorded on the genus *Salix*, and on lowland and montane species of *Salix*, with number of RDB species.

	All <i>Salix</i> species	Lowland species	Montane species
Total	752	479	45
Lepidoptera	296	214	4
Hemiptera	124	79	10
Coleoptera	160	59	6
Hymenoptera	106	73	15
Diptera	46	42	7
Acari	15	10	3
Thysanoptera	5	2	0
Total RDB	81	43	8

Table 3.10 Insect species associated with scrub habitats with Priority Species status in the UK Biodiversity Action Plan.

Scientific name	English name	Scrub habitats
<i>Boloria euphrosyne</i>	Pearl-bordered fritillary	woodland clearings, scattered scrub
<i>Carterocephalus palaemon</i>	Chequered skipper butterfly	woodland edges, scrub & grassland
<i>Cicadetta montana</i>	New Forest cicada	open scrub, woodland edges
<i>Cryptocephalus coryli</i>	a leaf beetle	hazel (woodland edges), birch (heathland)
<i>Cryptocephalus decemmaculatus</i>	a leaf beetle	willow & birch growing in bogs
<i>Cryptocephalus nitidulus</i>	a leaf beetle	birch & hazel, downland scrub
<i>Cyclophora pendularia</i>	Dingy mocha moth	willow, heaths, scrub
<i>Doros profuges (=conopseus)</i>	a hoverfly	scrub, wood edges, calcareous grasslands
<i>Formica rufa</i>	Southern wood ant	woodland clearings, heath & scrub
<i>Formicoscenus nitidulus</i>	Shining guest ant	bracken
<i>Melanapion minimum</i>	a weevil	wood margins, willow carr
<i>Paradiarsia sobrina</i>	Cousin German	young birch
<i>Polia bombycina</i>	Pale shining brown butterfly	scrubby grassland
<i>Procas granulicollis</i>	a weevil	woodland edges, bracken
<i>Trichopteryx polycommata</i>	Bare tooth-striped moth	woodland clearings, chalk downland
<i>Xestia rhomboidea</i>	Square-spotted clay moth	scrub patches

3.2.5 Reptiles and amphibians

Reptiles and amphibians use scrub for a variety of reasons, as foraging habitat, as resting areas, as an aid to thermoregulation and for hibernation. Reptiles utilise mosaics of scrub and more open areas of vegetation for thermoregulation. Scrub/grassland edges are particularly important for basking snakes and lizards (J. Foster, pers. comm.). Scrub encroachment is listed as a threat for two priority species in the UK BAP, namely the pool frog *Rana lessonae* and the sand lizard *Lacerta agilis*. Whilst scrub invasion, especially of heathlands, is a threat to several species of reptile and amphibian, inappropriate scrub clearance can be just as damaging. Attention needs to be given to both the spatial arrangement of clearance within a vegetation mosaic, and the seasonal timing of operations, in order to protect these species.

Only four correspondents to the questionnaire mentioned the value of scrub for amphibians and reptiles. Winter cover for amphibians was important in west Wales, nesting habitat for reptiles in Sussex, berries for sand lizards in Dorset, and as adder *Vipera berus* habitat in Wiltshire. There is little doubt that scrub has value for other herpetofauna, but good research information is lacking.

3.2.6 Mammals

Many mammal species use woodland, especially woodland edge, as a primary or secondary habitat, including badger *Meles meles*, red fox *Vulpes vulpes*, rabbit *Oryctolagus cuniculus* and various deer, use scrub as substitute for woodland. A range of small mammal species are likely to be favoured by the increase in shelter and structural diversity resulting from scrub development on grassland sites, but there does not appear to be any published information.

The value of scrub to small mammals in general was mentioned by only two survey correspondents. However, its importance for dormice *Muscardinus avellanarius* was noted by eight correspondents from southern England and Pembrokeshire. Recent research in Dorset has shown that dormice use ancient hedges and both inland scrub and coastal scrub as well as woodland, particularly if nest boxes are supplied (Eden & Eden 1999).