

6 Recommendations

6.1 Research and education requirements

The following research and education requirements were identified during an expert workshop held at English Nature headquarters, Peterborough, in November 1999. Additional comments have been added from the results of a questionnaire circulated to 125 conservation professionals (see Section 6.2).

6.1.1 Classification

Describing vegetation types according to the plant species present provides a common currency, or template, on which discussion of issues linked to scrub types can be based.

6.1.1.1 Survey

Many species (plant and animal) of scrub habitats are perceived to be rare, but this rarity cannot be quantified because insufficient distribution data for individual species or scrub types are available. This requires a structured inventory of the geographical distribution of key species (e.g. Biodiversity Action Plan (BAP) species) and habitat types, for example by region or Natural Area. A list of scrub habitats, mapped to NVC level at regular intervals (e.g. every 5 years) on all SSSIs, would provide an excellent basis for comment on species and habitat distributions. Phase 1 databases from Wales are being used to produce scrub distribution maps, with interesting results (J. Latham, pers. comm.) The rapid rates of change of scrub habitat (stand areas, size and architecture of species, community composition, etc.) are acknowledged to be a problem when compiling distribution lists and maps, as the nature of the resource can change rapidly. This is more relevant in lowland than upland areas, because of more rapid growth rates and therefore community change. Identifying and mapping the geographical distribution of species which are key indicators of change is thus viewed as the most practical approach to identifying current and future scrub distribution.

Key species could be divided into those indicative of:

- Pressures (factors driving the change, e.g. socio-economic factors);
- State (condition of the habitat type as a result of the pressures);
- Response (changes resulting from management and restoration, including those resulting from political response to states and pressures).

6.1.1.2 Spatial structure

Spatial structure (architecture and physiognomy) within a stand of scrub is thought to be important for many taxa, and might provide a suitable basis for a new, easy to use, habitat classification. Work on birds, such as nightingales, has highlighted the importance of structure when identifying suitable habitat (Fuller *et al.* 1999). Identifying a suitable measure of structure might thus be a major component of, or addition to, habitat classification. The role of a mosaic of scrub habitats, particularly at the scrub/grassland or scrub/wetland edge, in species distribution is considered to be important. This includes the optimum scrub/grassland ratio for different species that benefit from scrub cover, including scattered bushes, and the value of different densities of scattered scrub.

6.1.1.3 Life form

Regenerative strategy and physical structure varies greatly between plant species, and may be one of the factors influencing the associated species present. For example, juniper *Juniperus communis* and bramble *Rubus fruticosus* agg. have very different life forms and associated invertebrate fauna.

6.1.1.4 Successional dynamics

The impact on associated species of the pace and trajectory of succession within a stand is likely to be major, but little information is available. The rate of succession (e.g. illustrated by the speed of canopy closure) is likely to vary with geographical location. An upland/lowland split is expected due to much slower growth rates of the same species in upland areas.

6.1.2 Physical conditions

6.1.2.1 Nutrient cycling

The rates of nutrient cycling and associated soil dynamics are influenced by community composition and structure. An understanding of these fluxes gives us an idea of both the visible and microbial communities, and the likely influence on these of current and future management.

6.1.2.2 Water relations

Watershed management is influenced by the quantity and distribution of scrub present. Scrub removes large quantities of water from the soil and surroundings through evapo-transpiration, yet some physical structures impede water flow. An increase in scrub on flood plains may thus increase flooding, which can be perceived as either a positive or a negative event, depending on the remit of the manager. Investigation of the role of individual species, habitat types and physical structures on watershed management would enable compromise between the requirements of managers to minimise unacceptable flooding whilst maximising the ecological values of wetland scrub types.

6.1.2.3 Soil stability

Establishment of scrub can be a useful tool for stabilising soil. A list of the most suitable species and groupings for different situations is needed. If this information exists (e.g. unpublished data and anecdotal information within the Environment Agency), then it needs to be more widely disseminated.

6.1.2.4 Implications of land-use history

Land-use history impacts on the outcome of current and future management, and must be considered when undertaking work on scrub. Past land management is known to influence subsequent grassland communities (Wells *et al.* 1976, Dutoit & Alard 1995) and is also likely to influence scrub community composition and development. This is a major area that needs to be investigated.

6.1.2.5 Microclimatic aspects

The range of microclimates available within a scrub type impact on both the scrub species and the associated organisms. Knowledge of the microclimatic conditions within scrub types,

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and the criteria influencing those conditions, would provide insights into the requirements of associated species.

6.1.3 Biotic interactions

6.1.3.1 Scrub species/habitats attributes

Each scrub species and habitat type provides a set of ecological conditions (template) used by associated groups of organisms such as birds or insects with those specific requirements. Knowledge of the template available should make it possible to predict the potential for associated species with known requirements occurring at a given location.

6.1.3.2 Range attributes

Matching species and habitat type attributes is not always sufficient to predict the presence of a species. For example, some species of insects associated with juniper (Ward 1973) are absent from large areas of apparently suitable juniper scrub, due to differences in geographical range. Information on ranges of individual species is therefore needed in addition to species attributes in order to judge the importance of a scrub habitat type for associated species.

6.1.3.3 Habitat characteristics in terms of species assemblages

The three-dimensional structure, food sources available, and the life-strategies of both shrub and associated species all contribute to the habitat characteristics of a scrub type. Knowledge of all these factors is required if the likelihood of a species being present is to be estimated. Collation of existing data on the value of different scrub types for species linked to scrub would be useful for site managers planning management aimed at key or BAP species such as Black grouse *Tetrao tetrix*, or juniper.

6.1.3.4 Patterns of colonisation processes - modelling

Colonisation depends on a range of biotic interactions and physical attributes. Modelling using these parameters may be a suitable approach to identifying colonisation patterns, and therefore predicting likely outcomes of clearance, or problems of scrub encroaching onto other, more highly valued habitats.

6.1.3.4 Seed dispersal

Seed size, weight, numbers produced, dispersal method and life cycle influence distribution of scrub species. These factors limiting colonisation are known for only a limited number of species (e.g. hawthorn *Crataegus monogyna* and dogwood *Cornus sanguinea*), but have a major impact on the outcome of management such as scrub clearance.

6.1.3.5 Herbivore effects on scrub dynamics

Herbivory plays a central role in most ecosystems, including scrub habitats. Insect herbivory is likely to have the greatest impact on scrub dynamics, but relatively little work has been done on scrub habitats *per se* (but see Ward 1972, 1973, Ward & Spalding 1993).

6.1.3.6 Mini-island biogeography

The non-uniform spatial distribution of shrubs within a stand of scrub frequently creates a mosaic of habitat types. Factors such as patch size, distance from other suitable patch, and age of patch may all influence the species present. A combination of island biogeography and metapopulation theories may be suitable to explain species distribution within this framework. This approach has been successfully used to predict species distribution within large geographical areas. The location of scrub in relation to other habitats is likely to influence the species composition of both

habitats, but little such work has been carried out on species associated with scrub.

6.1.4 Management

The management options available to site managers, and the methods practiced, are influenced by the criteria listed above (classification, perception and ecological interactions sections).

6.1.4.1 Agri-environment values influence management options

The type of land management practiced varies between stakeholders, but is invariably dictated by the time and money available. For example, a conservation organisation might be able to use volunteers to carry out a labour-intensive method of management, but this would not be an option for a farmer (see section on stakeholder perception) unless sufficient finances were made available, for example through agri-environment schemes.

6.1.4.2 Organic vs. conventional farming practices

Scrub dynamics will be influenced by the agricultural systems practised in the landscape. The most dramatic contrasts are seen between organic and conventional farming practices. This will be most pronounced in scrub stands with a high edge : area ratio, such as scrub/ grassland mosaics.

6.1.4.3 Intervention vs. natural regeneration

The vegetation communities resulting from natural regeneration following scrub clearance often contain a high proportion of tall, weedy species. These may be very different from those of the target habitat envisaged by the site manager. These sites may be viewed as 'failed' restoration areas, despite the extremely short time-scale within this perception is formed (months, as opposed to the decades it routinely takes until the success of a site restoration project can fairly be judged). Weedy communities can also be viewed as providing useful diversity on some sites, and are by their nature transitory. Many managers however prefer to minimise the unkempt appearance of a site, and seed newly cleared areas with a species-mix similar to that of their target community. Opinion as to the efficacy and possible complementarity of the two approaches is divided, and a set of guidelines for managers on the best approach for identifying, and achieving, their target communities on newly cleared sites is urgently needed.

6.1.4.4 'Tweaking' succession

Most scrub types (other than exposed cliffs, some upland areas etc) inhabit mid-successional seral stages which require management to prevent succession. Ideally, a stand of scrub would be dynamic, and would constantly change its location within the landscape, providing a full array of seral stages and merging into the surrounding habitats (e.g. grassland/scrub mosaic on the edge of chalk grassland). However, this is not practical under the current agricultural climate, so stands need to be maintained *in situ*. This is both labour intensive, and of limited success. There is an urgent need for more information on the success of existing management methods (e.g. rotational management by cutting, length of rotation, follow-up management), and an exploration of novel, innovative approaches, such as the combined effect of cutting and browsing or grazing.

6.1.4.5 Criteria for success

Key targets for cleared areas are needed, so managers can identify what they are trying to achieve when managing an area. Management such as rotational cutting is very resource costly, often carried out on an *ad hoc* basis, and informed by insufficient knowledge of the likely outcomes of management on an area. The

use of indicator species, or key structure measurements, could inform decisions on what, where, when and how to manage.

6.1.4.6 Thresholds for management

Age and composition of scrub habitat type, size of block, and surrounding land-uses, will influence the end result of management. The most suitable management of different scrub types, taking into account age, species present, structure, and level of canopy closure, could be identified using a set of thresholds. For example, if the required outcome of scrub clearance was restoration of abandoned chalk grassland, natural regeneration might be recommended if canopy closure was less than 50% and chalk grassland of high nature conservation value was present within 50 m; but if the canopy was closed, and there was no suitable seed source within 200 m, soil stripping and sowing with native seed might be the most viable option. Alternatively, a different target end community might be suggested. This approach would be both useful to guide managers, and essential to maximise value for money of operations such as scrub clearance under agri-environment schemes.

6.1.4.7 Alien invasive species

A sound knowledge of the geographical distribution and ecology of the range of alien species occurring in scrub is required. Many are regarded as undesirable invasives, for example butterfly-bush *Buddleja*, *Cotoneaster*, aromatic wintergreens *Gaultheria* and rhododendron *Rhododendron ponticum*. Information on these species is required in order to understand the extent of the problem and advise on effective management.

6.1.5 Perception

Conservation of valuable scrub will only be successful if the needs of the majority of stakeholders are addressed, which requires a knowledge of how scrub is perceived by non-conservationists.

6.1.5.1 Education

Factual information on scrub, and the key issues surrounding its ecology and conservation, should be disseminated to a wide audience. This informs stakeholders, and can be used to influence perception of scrub.

6.1.5.2 Stakeholder perception

Stakeholder perception of the socio-economic, and economic, factors linked to scrub conservation and management need to be surveyed. Surveys can be used to identify the types of information or actions most likely to engender a more favourable attitude towards scrub. For example, a large stand of species-rich scrub encroaching onto adjacent pasture might be considered as a problem by a lowland farmer with insufficient resources to prevent rapid spread. However, if the nature conservation value of that scrub type were recognised, and sufficient agri-environment funding made available for appropriate management, the farmer would no longer view the scrub as a problem.

6.1.5.3 Guidelines

Practical information guiding management of scrub to optimise its conservation value is required. Broad management recommendations are currently available in disparate publications focussing on specific habitats or groups (e.g. lowland grassland (Crofts & Jefferson 1999, Jefferson & Robertson 1996); butterflies (NCC 1986); birds (Fuller 1995)). A single publication focussing on the management options (pros and cons) suitable for the full range of scrub habitat types is viewed as essential. Information could be drawn from published and unpublished information, and could include advice on best practice for scrub habitat creation and restoration and consider scrub management in context with other habitats present on a site or the surrounding landscape. This might usefully follow the format used by Dryden (1997). Scrub is often considered as a problem by managers because they have insufficient information to identify the most suitable management options (see Section 5.3).

6.2 Site management and agri-environment policy

6.2.1 Survey of specialists and advisors

6.2.1.1 Background

All the opinions expressed below were gathered as part of a survey of specialists and advisors with responsibility for providing advice or awarding grants at the county or regional level. A total of 125 questionnaires (Appendix 6.1) were sent out, although a greater number may have been circulated as recipients were encouraged to copy the questionnaire to other relevant members of their organisation. The breakdown of responses is shown in Table 6.1.

Table 6.1 Breakdown of responses to questionnaire on changes in scrub policy by affiliation and area of responsibility.

Body	Comments relating to:					Total
	Lowland only	Lowland/Upland	Upland only	Country/region		
EN	8	0	0	0	8	
CCW	0	2	0	3	5	
SNH	3	3	1	0	7	
FWAG	18	5	0	0	23	
FRCA	15	5	1	0	21	
Other	0	2	0	1	3	
Total	44	17	2	4	67	

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CCW	0	2	0	3	5
SNH	3	3	1	0	7
FWAG	18	5	0	0	23
FRCA	15	5	1	0	21
Other	0	2	0	1	3
Total	44	17	2	4	67

A combination of the concentration of Farming and Rural Conservation Agency and Farming and Wildlife Advisory Group personnel in England, and lack of experience of administering Tir Gofal, has resulted in a much greater input into this section from England than the other countries. However, some responses represent the view of an organisation (e.g. Brian Pawson responded with CCW official policy on Tir Gofal), rather than the personal opinion of individual area representatives (e.g. FRCA and FWAG). Sixty individuals responded (Appendix 6.2)

6.2.1.2 General comments not referring to specific schemes

Thirty nine respondents commented on the general constraints (including current policy) limiting their promotion of scrub conservation. There was little apparent upland/lowland division of opinion over the omissions in existing policy on scrub management options individual schemes, which was unexpected given the more widespread, invasive nature of scrub in lowland areas.

The consensus of opinion (30% of responses) was that farmer perception of scrub as a low value/priority habitat needed to be addressed. The importance of promoting scrub 'as a habitat in its own right and in a mosaic with other habitats', was recognised by many respondents. This approach is already being piloted in Wales by the Tir Gofal scheme (CCW 1999), but is too early to assess the impact of this on attitudes towards scrub conservation. National Vegetation Classifications W21 (*Crataegus monogyna*–*Hedera helix*), W22 (*Prunus spinosa* – *Rubus fruticosus*), W23 (*Ulex europaeus*–*Rubus fruticosus*) and W24 (*Rubus fruticosus*–*Holcus lanatus*), W1 and W2 (*Salix cinerea* woodlands), are recognised as scrub within Tir Gofal. The Rural Stewardship Scheme (replacing the Countryside Premium Scheme) to be launched by Spring 2001 in Scotland addresses the management of native or semi-natural woodland and scrub. However, documentation was unavailable at the time of writing to compare this with existing Forestry Commission grants such as Woodland Grant Scheme and Farm Woodland Premium Scheme, or to assess the potential impact of this new scheme.

Farmers, landowners and staff were seen as having little interest in scrub as a habitat, preferring to either remove scrub completely, or to 'avoid touching scrub', rather than undertake any intermediate management.

Common reasons attributed to farmers and land managers for wanting to clear scrub included: to increase the areas available for grazing; avoiding deductions made for ungrazed/ungrazable areas; to reduce the cover for predators such as corvids; or because many land managers view scrub as a sign of abandonment and therefore poor land management. 'Persuading farmers not to clear scrub unnecessarily' was viewed as an up-hill struggle, requiring time and patience. Common reasons attributed to farmers and land managers for non-intervention included: 'because it provides good shelter'; insufficient 'agreement holder/contractor skills'; length of time period commitment required to manage scrub effectively; physical site restraints (distance, steep/rough terrain); financial constraints; and 'lack of sufficient livestock' to provide follow-on grazing.

Many respondents were keen to avoid this 'all or nothing' approach to scrub management, and suggested that 'annual management payments for keeping scrub as a habitat' would be a useful addition to existing agri-environment and Forestry Commission policies. Current policy for the Countryside Stewardship and English Environmentally Sensitive Area schemes funds scrub management as an item of capital expenditure, but has no provision for annual management of scrub (cf. grassland management; Scottish ESAs; Tir Gofal; Countryside Premium Scheme). Increased incentives for better management of scrub on habitats where neglect is resulting in loss of habitat/ diversity' were suggested. Several respondents felt that 'lower financial limits in conservation plans' were not enough, and that grant rates were 'not sufficient inducement for farmers to carry out necessary work'. Grants 'to increase the amount of scrub, for example by planting on improved grassland or arable sites', were suggested. Management of a site to include selective removal of plants/shrubs to maintain it as scrub, not woodland, was also proposed. It was also proposed that a 'more generous view of native scrub in peripheral areas' should be included in schemes relating to scrub management.

Although this was not the general feeling amongst respondents, there was the suggestion that the role of scrub 'as a component of a range of habitats' was sometimes overlooked by advisors in their desire to clear scrub to increase the area of existing habitats of known conservation value. The potential for give poor management advice, because of insufficient information on the most valuable types of scrub (including requirements of Biodiversity Action Plan species), was seen as a major problem. The suggestions given above for modifications to scrub policy were tempered by a desire to avoid further mistakes caused by adopting new policies without a sufficiently robust science base. This was a concern for several individuals, particularly those involved in providing advice at a regional level. Research into the value of scrub stand types, within a regional context, and including mammals, birds, rare invertebrates and their habitat regimes, was suggested as requiring attention (see Section 6.1).

6.2.1.3 Individual schemes funding scrub management

Woodland Grant Scheme (Forestry Commission)

Thirteen respondents, of which eleven were affiliated to FWAG, specifically mentioned the WGS as needing amendment. This constitutes nearly 50% of FWAG representatives returning the questionnaire, suggesting that a desire for changes in the WGS is widespread amongst 'hands on' professionals offering practical advice to farmers.

The common thread running through responses was that the 'Woodland Grant Scheme does not seem to like scrub', and does not promote conservation of scrub as a valuable habitat in its own right. Adaptation of WGS and FWPS was suggested to include payments for managing and increasing the area of existing scrub, for example by thinning/removing trees, or encouraging scrub regeneration. An annual payment spread over, for example, 10 years (equivalent to grassland management), was suggested as a way of 'presenting scrub creation and management as a valid practice in the eyes of the landowners'. The detrimental effects on scrub of some WGS payments were raised several times. The existing 50% funding rule, which leaves farmers unable to match funds with other grants, was criticised, as was the dilemma posed by the 'difficulty of advising on the retention of scrub when there is generally no management payment available against destruction by tree planting under WGS'.

Several respondents were concerned that the percentage of shrubs allowed to be planted in a new woodland (currently a maximum of 10%) was too low (20% was suggested as a more useful value). The WGS approach towards scrub management was perceived as failing to take into account that 'all schemes need to be flexible as scrub is not a fixed habitat'. Management of smaller blocks, possibly to include coppicing after 5 years (currently 30 years) was also proposed.

Countryside Stewardship Scheme

Many of the suggestions for future changes of WGS were also proposed for the Countryside Stewardship scheme. Of the 14 respondents that mentioned the CS scheme, nearly half were concerned that the scheme was aimed, or perceived to be aimed, at scrub removal rather than management. Although CS scheme guidelines for scrub present lowland scrub as a potentially valuable habitat, payments are made for scrub clearance only, with no funding for a management component. Management payments to enhance or increase the extent of scrub of high nature conservation value were considered by many to be a missing element of the Countryside Stewardship scheme; many would like to see 'scrub conservation properly incorporated into CS, i.e. management guidelines in pack, payment specified, compliance management specified, included in targets/objectives, etc.'. This would 'involve a

longer term commitment on behalf of the landowner', but a sympathetic scrub management agreement, which might include creation and management, such as dividing up large blocks, or coppicing, was seen as highly beneficial to scrub conservation.

Interestingly, interpretation of CS regulations may vary between individuals, with several respondents (both upland and lowland areas) commenting that 'the flexibility of CS allows sympathetic scrub management', and that there are 'no constraints' to scrub management within the CS scheme.

The issue of level of annual payments was raised by several individuals in relation to CS. The base payment for scrub management in upland areas is less (£55/ha/year) than for management of other habitats (£80/ha/year) which might lead to a perception amongst farmers that scrub is less valuable than other habitats. This is particularly relevant in upland areas, where scrub is often severely under represented in the landscape, and could be addressed by advisors promoting 'a greater understanding of the value of scrub as a habitat'. Lowland areas might benefit from higher payments for scrub management, as this could enable a more useful balance between prevention of scrub encroachment on to more highly valued habitats such as chalk grassland or lowland heath, and retention of scrub of high nature conservation value.

Environmentally Sensitive Area scheme

Relatively few responses (five) were received referring to scrub in ESAs, of which four were from FRCA staff, three of which related to upland areas. The fourth FRCA respondent was based within a lowland ESA, and found that there were 'few constraints on the promotion and conservation of scrub' under the ESA scheme. Responses recorded by the questionnaire suggest that guidelines in place in lowland ESAs may be sufficient for scrub conservation.

For example, current and future measures for scrub conservation in one southern lowland ESA 'are already in place', and 'if a situation arose when it was deemed necessary to promote or conserve scrub, the use of the 'catch-all' item 50 within the Conservation Plan ('other works for the restoration or enhancement of wildlife habitats') could be used'. This item appears to be infrequently used by project officers, and was not identified as commonly used for scrub conservation.

Generally, the existing policy on scrub was viewed favourably: 'with care it should be possible to manage/control scrub where desirable using conservation plan items 7 and 23 (management/control of scrub; management/control of bracken). It should also be possible to create scrub using items 24 (reversion of land to heathland) and 50 (see above)', although the amount of Project Officer time required to convince farmers of the value of scrub management was emphasised for one northern upland ESA. The only suggested modification was for a 'specific management tier supplement to be paid over and above the basic tier appropriate to the land' for example a supplementary payment of £15-£25 per hectare in exchange for following an agreed management agreement.

Countryside Premium Scheme

A single recipient commented on the Countryside Premium Scheme (CPS), probably reflecting the low number of the recipients in Scotland who responded to this policy questionnaire. The CPS contains 'a scrub management option to regenerate scrub, but which does not require the exclusion (or eradication) of deer and rabbits.' It was felt that 'this should be a requirement. The CPS definition was that it (scrub) should contain a variety of species, failing to recognise that in upland areas a single species can still be of high conservation value'.

Tir Gofal

As Tir Gofal was opened for applications in March 1999, no agreements are yet operational. However, 'lessons learned from Tir Cymen were used in developing Tir Gofal. In particular, the key advance in Tir Gofal is the recognition that scrub was worthy of treatment as a separate habitat in its own right' (B. Pawson, pers. comm).

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Sites of Special Scientific Interest

SSSI policy relating to scrub was suggested by representatives of EN providing advice at a regional level as needing modification. Identification of neglect as an operation likely to damage the interest of SSSIs, and the need to allow enforcement of appropriate scrub management in order to secure favourable conditions, were highlighted. 'Increased resources would inevitably be required to satisfy the resulting resource implications for restoration management'.

Biodiversity Action Plans

Production of a national Biodiversity Action Plan for scrub, and the inclusion of scrub as a component of other BAPs, was

suggested as likely to enable English Nature to maximise its impact on scrub conservation. Inclusion of objectives for scrub in Local BAPs was suggested by a representative of SNH as likely to improve the case for expenditure or management.

Future policies to benefit scrub conservation

Most suggestions for improvements to scrub conservation policy focussed, perhaps realistically, on modifications to existing schemes rather than new policies. However, there was a call for 'a more holistic land-use approach, particularly a more integrated approach to agricultural and forestry schemes such that scrub habitat does not fall outside'.

6.3 Recommendations

6.3.1 Classification and distribution

- The nature conservation value of scrub is generally related to its structure, including elements of both vertical canopy structure and horizontal spatial structure in relation to other habitats. The National Vegetation Classification, being based on floristic inventory of homogenous stands, is therefore inadequate for ascribing conservation value to scrub stands.
- There is a need for a structural classification of scrub that is ecologically meaningful in terms of the requirements of scrub-associated organisms, especially invertebrates and birds. This classification must take account of spatial structure (mosaics / patchiness), scrub height and foliage profiles.
- In order to assess the absolute and relative importance of scrub to nature conservation, whether regionally, nationally or within Europe, there is a need for better information on the distribution and extent of the major scrub types.
- Treatment of scrub within land cover surveys adopted by various agencies varies considerably. Much information on national distributions is potentially available within the ITE Countryside Survey 1990 and Countryside Survey 2000 databases but it is currently in aggregated form under the main category 'Shrub'. Dis-aggregation of this databases would provide information at the required level of detail.

6.3.2 Conservation status

- Certain rare scrub types (e.g. juniper scrub) or scrub composed of rare shrub species (e.g. woolly willow *Salix lanata*) have Habitat or Species Action Plans within the UK Biodiversity Action Plan. No changes to the definitions of broad or priority habitats are considered necessary. However, the conservation value of scrub as a structural component of many priority habitats needs to be fully acknowledged in relevant Habitat Action Plans.
- An assessment is needed of the extent to which scrub within SACs and SSSIs is representative of the wider resource and to decide whether further designations are required to cover under-represented scrub communities.
- Better information is needed on the status and management of scrub within existing SSSIs, including occurrence of scrub types, structural characteristics, associated species, conservation importance within the SSSI and management objectives.
- An assessment is needed of the ecological contexts in which scrub should form a criterion for SSSI designation. In addition, citations for existing SSSIs and definitions of 'favourable condition' may need to be changed to take account of the nature conservation value of scrub.
- Research is needed to determine for which species and under what circumstances scrub is a primary (or sole) habitat and when and where it is of secondary importance.
- Characterisation of the unique attributes of British scrub types in relation to those of mainland Europe is essential in order to set conservation priorities within the UK. A meeting of key European specialists could provide a starting point for a European network on managing scrub vegetation for nature conservation.

6.3.3 Ecology

- This review has identified the importance of mosaics of vegetation, of which scrub is an integral part, for several taxa. There is a need for research that identifies the optimum mosaic structures for ground flora, invertebrates and birds. This work needs to take account of the different scale requirements of these taxa and should take account of the importance of edges and glades within scrub.
- The processes of scrub establishment and the development of patchiness within scrub are poorly understood. In particular, there is a need to examine more closely the role of birds in seed dispersal and how their behaviour influences the distribution and spatial structure of scrub.
- A landscape approach to the importance of scrub for conservation needs to be developed. This could have two main components. First, an assessment of how the proximity of other habitats, especially woodland and grassland, affects the plant and animal communities found within scrub. Second, there is a need to determine the contribution that scrub makes to biodiversity within different landscape types relative to other habitats. The latter work would help to identify the extent to which species are dependent on scrub compared with other habitats and, therefore, clarify the complementarity of scrub and other habitats.
- Research is needed on the successional dynamics of animal communities (especially invertebrates, birds and small mammals) within developing scrub. Such research should seek to identify which are the richest stages of successional development, both in terms of species richness and the presence of species of particular conservation interest. These data would be valuable in helping to underpin management policies that sought to maintain rich communities of animals within scrub habitats.
- Carr has been remarkably little researched, especially concerning its animal communities and how these are influenced by factors such as successional stage and wetness. Further research in this area seems highly desirable in view of the current conservation interest in riparian woodland.
- Very little is known about the mycorrhizal associations of scrub species and, indeed, how these might benefit the rare communities. Manipulation may enhance the success of establishment or restoration of these communities, especially when soil conditions are not optimal.

6.3.4 Management

- Carefully controlled experimental research is needed to determine the effectiveness of differing procedures for scrub management, including those for maintaining scrub as well as controlling it. This should take account of existing guidelines and the considerable amount of information contained within the responses to the questionnaire carried out as part of the current study.
- In the context of scrub control, there is a need to identify whether critical thresholds of scrub development exist, beyond which scrub clearance is ineffective as a means of restoring habitats such as lowland calcareous grassland or fen.
- Research is especially needed on appropriate management techniques for maintaining patchiness and mosaics. Rotational large-scale cutting of scrub is unlikely to be adequate for maintaining complex vegetation mosaics and approaches that adopt grazing or combinations of grazing and selective cutting are likely to be more successful.
- A scrub management handbook should be developed outlining best practice for managing scrub, especially means of encouraging sustainable mosaics of scrub and other habitats.

6.3.5 Dissemination and Education

- A major constraint on the conservation of scrub and its associated species is the widely-held opinion that scrub is of low conservation value and primarily a threat to other more valuable habitats. Methods of addressing this problem of perception need to be developed.
- In particular, there is currently insufficient guidance concerning situations where scrub is valuable and in which contexts other conservation priorities take precedence. This problem is exacerbated by the linkages between the conservation value of scrub and its intimate association with other communities in habitat mosaics.
- It would be highly desirable to establish a network of scrub demonstration sites where different approaches to difficult scrub management issues can be viewed and discussed with site managers.

6.3.6 Agri-Environmental Policy

- In most situations, scrub is primarily considered as a threat to other habitats, and capital payments allocated for clearance. Funding for agri-environment schemes needs to take account of both the efficacy of scrub clearance for restoring species-rich herbaceous communities, such as chalk grassland, and the intrinsic nature conservation value of scrub or habitat mosaics including scrub.
- The introduction of annual management payments to conserve and enhance scrub of high conservation value in England (as opposed to one-off capital payments for clearance) would benefit scrub conservation, and bring the English agri-environment schemes into line with those in Wales and Scotland.
- Little attention is paid to the roles of landscape processes when funding scrub management, despite the likely impact of the surrounding landscape on the value of individual habitat patches. A consideration of the large-scale spatial processes should be taken into account when allocating funding for scrub management. This approach relies on scrub of high conservation value being identified in funding applications, something that is currently not addressed.

6.3.7 Landscape Policy

- Conservation of seral scrub can only be achieved on a large spatial scale, enabling management to produce mosaics of scrub at different successional stages.
- Wherever appropriate, scrub should be encouraged as part of natural vegetation dynamics. For example, in the Scottish Highlands there may be increasing opportunities to regenerate natural woodland cover in which scrub is present not just in the initial establishment phase but also in the longer term as a natural component of the forest dynamics following disturbance by windblow or fire.
- A more positive approach to scrub habitats is required in the uplands of England and Wales to match that adopted in Scotland. For example, it would be interesting to consider how treeline scrub communities may be enhanced in Snowdonia and the Lake District; how scrub communities may play an important role in 'wild-wood' developed on former conifer forest sites; how upland hawthorn scrub may be regenerated and extended under agri-environment schemes; how willow scrub may be used to enhance and link wet woodland habitats.
- Landscape policies that promote the large-scale expansion of scrub on lowland flood plains would contribute significantly to the conservation of residual alluvial forest (a priority habitat in the Habitats Directive) and delivery of the Habitat Action Plan for wet woodland.
- Scrub and associated wet woodland communities frequently develop on abandoned mineral extraction sites. Promoting the nature conservation value of such sites amongst mineral planning officers would provide opportunities for expansion of these habitats and their appropriate management.
- Within the context of agricultural land, abandonment may provide opportunities for the creation of scrub habitats. Issues of negative perceptions of the value of scrub amongst landowners need to be addressed.
- The use of scrub buffer strips adjacent to new farm woodlands would contribute significantly to the nature conservation value of such plantations.
- The nature conservation value of scrub, and of mosaics of scrub, woodland and herbaceous communities, needs to be recognised in the planning of new lowland woods and national forests.