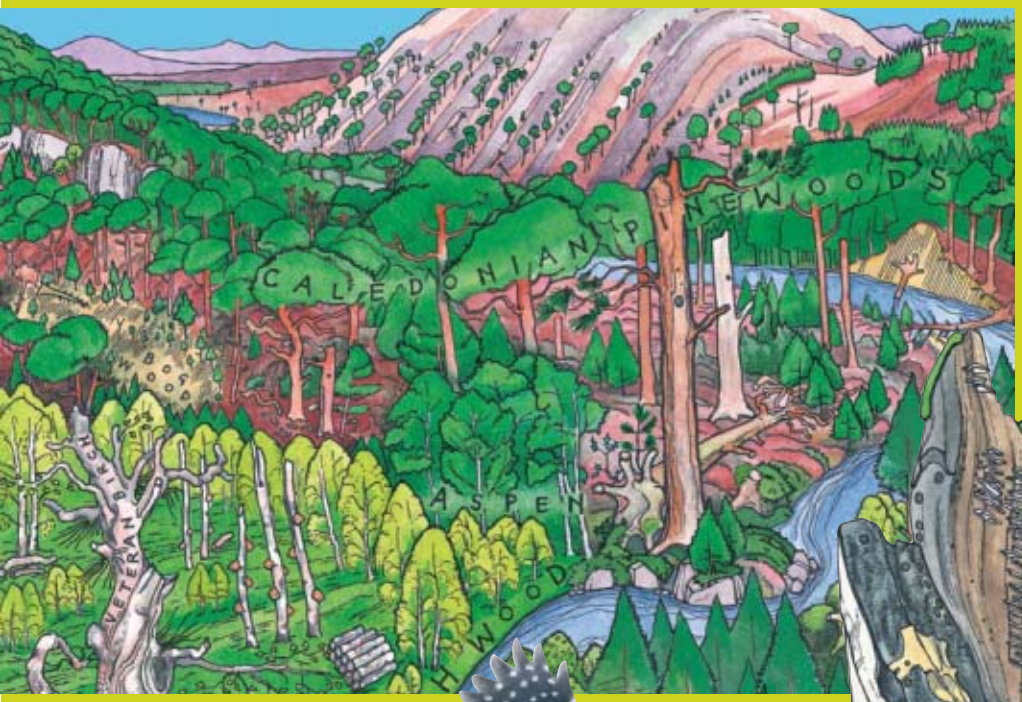
Bringing forests alive!

Forest Enterprise

life in the DEADWOOD

A guide to managing deadwood in Forestry Commission forests



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Foreword

The nation's woods and forests managed by Forest Enterprise are currently undergoing a massive transformation. Native woodlands are being restored and expanded whilst the large post-war forests, established as predominantly even-aged conifer plantation, are being redesigned. This involves diversification of age classes through planned, sequential felling of coupes followed by restocking with a greater range of species including a higher proportion of broadleaves. Some stands of timber will be managed using silvicultural systems which avoid clear felling and utilise natural regeneration. Areas will be left unplanted as important open habitats to link key sites and encourage wildlife to move through the forest landscape.

Forest Enterprise has recognised the importance of such 'macro' landscape scale changes to forest structure. Increasingly our managers are turning to the equally important 'midi' and 'micro' scale aspects of management which will benefit forest ecosystems and hence biodiversity. One such activity is the imaginative creation and appropriate management of deadwood. Historically, managers removed deadwood as a hygiene measure to protect the timber resource from what were perceived to be dangerous threats from insect and fungal attack. This has resulted in levels of deadwood in British woodland which are too low for sustaining populations of many woodland species of key conservation importance. Forest Enterprise is committed to rectifying this biodiversity deficiency. This guide is primarily intended to help our staff – managers and planners, as well as frontline wildlife rangers and machine operators – play their part in increasing the volume of beneficial deadwood in Forestry Commission forests. However, this guide should also provide valuable insight into deadwood management for other forest managers, our stakeholders, students and all with an interest in life in the deadwood.

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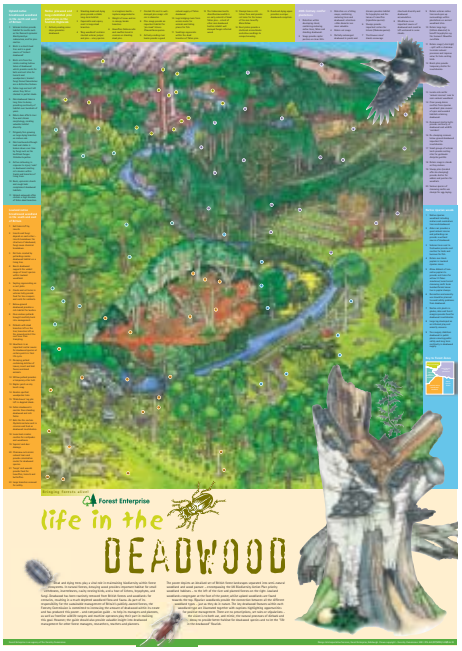
Introduction

Dead and dying trees play a key role in the functioning and productivity of forest ecosystems through effects on biodiversity, carbon storage, soil nutrient cycling, energy flows, hydrological processes, and natural regeneration of trees. Recognition of the value of deadwood for biodiversity (Ratcliffe, 1993) has led to the development of standards and guidelines for managed forests, which are in the process of being implemented (e.g. Anon, 2000a; Anon, 1998; Hodge and Peterken, 1998; Kirby *et al.,* 1998; Ferris-Kaan *et al.,* 1993).

The purpose of this guide is to:

- **Inspire those who are required to implement current deadwood guidelines at both the forest planning and operational levels;**
- **Illustrate how deadwood habitats can best be created and enhanced within different types of managed forest;**
- **Help with the production of local deadwood plans;**
- **Encourage all those who have an interest in the management of deadwood to make the best of opportunities when they arise and to develop a long-term perspective;**
- **Support Forest Enterprise in its aim to undertake sustainable forest management to the UKWAS standard and ensure that its wood products carry the FSC green label.**

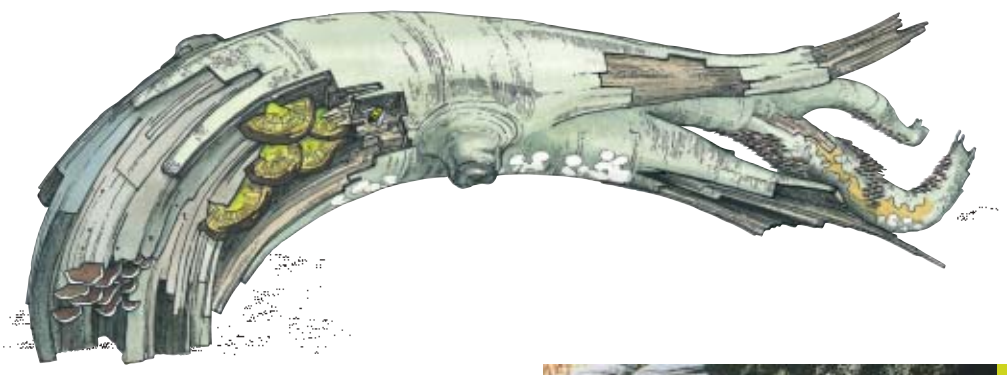


Working with nature: a future vision

In North America and Scandinavia the principle of basing sustainable management of commercial forests on the dynamics of natural forest types is well established, and the provision of deadwood is seen as an integral part of stand management approaches based on natural disturbance regimes. In Britain, we are still some way from adopting this approach. Our remaining ancient and semi-natural woodlands have been highly modified over several millennia and do not represent adequate examples of natural forest dynamics. Nevertheless on the best sites, we can still see the imprint of past naturalness in the remaining habitats and species, and these can provide some guidance as to what to create in our managed forests. The vision is to work with natural processes such as wind, dieback and decay, allowing these to have a greater influence on the structure and dynamics of our managed forests including the provision of better habitat for deadwood species.

Scope of the guide

This guide is focused primarily on managed conifer and broadleaved forests (both of planted and semi-natural origin) where there is scope for improving deadwood habitats to benefit both generalist and specialist saproxylic species. *The guidance comprises this booklet and the accompanying poster tucked into the rear cover. The idealised forest landscape on the front of the poster is divided into the main semi-natural woodland and wood pasture types to the left of the river and the main planted forests types on the right. Both planted and semi-natural types are divided broadly into upland/lowland broadleaved/conifer types following the UK Biodiversity Action Plan woodland categories (Anon, 1995). The main deadwood features within each woodland type are illustrated and described, showing how the occurrence of deadwood in semi-natural woods can be used as a guide for deadwood management within the planted forests.* The focus is primarily at the forest and habitat scales, with no particular emphasis given to rare species, or species with a very restricted distribution unless these help to highlight some general principles. Uncommon words and terms are described in the Glossary (page 18). Guidelines for special sites such as ancient parkland and wood pasture with veteran trees have been adequately covered elsewhere (Read, 1999; Harding and Rose, 1986) and are not included specifically in this guide, although some of the principles are adopted. The guidance here should be considered alongside guidance for other aspects of biodiversity and within the context of other management priorities such as timber, recreation and public safety (see Anon, 2000b; Bell, 1998; Anon, 1992).



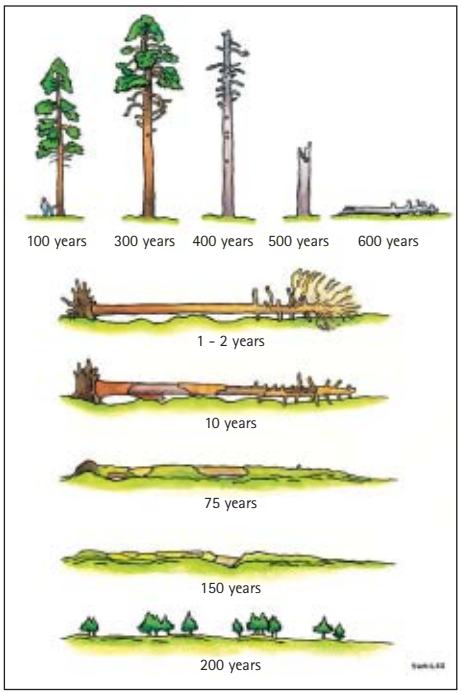
life in the DEADWOOD

The value of deadwood as a habitat for wildlife

In natural temperate and boreal forests, decaying wood provides important habitat for small vertebrates, invertebrates, fish (wood in water courses), cavity nesting birds, and a host of lichens and bryophytes, polypores and other saproxylic fungi. Different species require different types and quality of deadwood. Important factors include: time since death, size, whether standing or fallen, tree species and stage of decay. In general, larger pieces of deadwood have more micro-habitats and support more species than small pieces. But this is not always the case; sometimes a large volume of small deadwood is just as good as a small volume of large deadwood particularly for some fungi. Deadwood habitat also occurs on living trees in the form of rot holes, dead limbs, decay columns and heartrot, and these features all have their own associated flora and fauna. In natural forests, droughts, storms, insect disease and fire are the most important factors which kill trees and create deadwood. These disturbance factors vary in scale and intensity, leading to a patchy distribution of deadwood both at the stand and landscape scales with greater accumulations near canopy gaps and in old-growth stands. In the UK, substantial accumulations of deadwood are found only in old-growth forest reserves or in remnant habitat with old trees such as ancient parkland and wood pasture (Harding and Rose, 1986). A large percentage of rare and endangered saproxlyic species are often restricted to these relict habitats. Many of these species are poor colonists with exacting habitat requirements which are only found where management has allowed for continuity of mature trees and deadwood. On the other hand, more recent research has shown that quite considerable gains in biodiversity can be made by increasing volumes of deadwood in plantations. The benefits are most obvious for common and widespread deadwood species (important in themselves for ecosystem functioning) but also some of the rarer and more exacting species (see plantation section page 12).

Deadwood in water courses

Deadwood plays a vital role in the functioning of river ecosystems by: helping to retain water and sediments; trapping and facilitating the breakdown of organic matter into food for aquatic invertebrates, diversifying channels by creating pools, falls and riffles and improving physical habitat structure for fish and invertebrates. Recent research has shown that moderate accumulations of larger deadwood (>10cm in width, >1m in length) in headwater streams (channels of up to 10m in width) will benefit migratory fish populations, and aquatic invertebrates (see Linstead and Gurnell, 1999). The natural spacing of deadwood accumulations - debris dams - is about the equivalent of 7-10 times the channel width. Deadwood is a also a feature of natural bog woodlands, and the margins of ponds, lakes and other water features.



Process of decay in standing and fallen deadwood.

Strategic priorities for deadwood

Current guidance (UKWAS, 2000; Hodge and Peterken, 1998) recommends that a minimum of least 3 standing and 3 fallen pieces of deadwood or at least a volume of 5m^3 per ha of pieces >15-20cm diameter should be maintained, on average, across the forest area as a whole. There are benefits associated with spreading deadwood generally throughout the forest. Recent evidence suggest that even small amounts of deadwood can benefit the more mobile and generalist saproxylic species. These species assemblages make up an important part of the forest system, by playing a role in decomposition processes and acting as a food source for species further up the food chain. Fortunately, normal management activities such as thinning, and leaving harvesting residues on site after clear felling should cater for these generalist species, and there is no need for additional management guidance. To enhance habitat for more exacting species, the provision of deadwood should be targeted where it will provide added value to existing habitat, expand habitat area and improve linkage between habitats.

Three principles which determine the potential value of deadwood within a woodland or stand of trees are:

- **Site history: continuity of mature timber and deadwood habitat over a long period.**
- **Nature of the surrounding landscape: i.e. adjacency to existing ancient semi-natural woodland and other deadwood habitat.**
- **Past and current management: i.e. whether managed as high forest, coppice, minimal intervention etc. Sites which have been unmanaged for over 60 years can have high volumes of deadwood – sites which have been repeatedly felled are currently less valuable (although old coppice stools can harbour characteristic deadwood invertebrates).**

Table 1 shows a list of woodland types in descending order of importance for the provision of deadwood habitats. Summary management strategies and guidance are included for each type. Further guidance on how to assess the potential value of your wood for deadwood in England is given in a companion leaflet produced by the England Native Woodland Partnership (in prep).

Table 1: Strategic approach to identifying priorities for deadwood management (adapted from Hodge and Peterken, 1998)

Note: The creation of deadwood habitat poses potential risks to health and safety. Site risk assessments should be carried out prior to undertaking any work.

Woodland type	Characteristics	Management Strategy	Management guidance and suggested benchmark values for deadwood
Ancient semi-natural woodland (ASNW), including wood pastures, parkland, and high forests which support a rich saproxylic flora and fauna with many notable species.	Continuity of mature timber habitat over a long time-scale. History of veteran tree management (pollarding). Grazing of pasture reducing scrub regeneration. Low intensity of management in high forests, with effects of natural disturbance evident.	Identify and protect key sites, including designated areas e.g. NNRs, SSSIs, SACs etc. Conserve and enhance existing veteran trees and deadwood. Permit natural processes with a view to achieving natural levels of deadwood within a 100 year time frame.	**For wood pasture and parkland** • Follow guidance in Read (1999). **For high forests** • Minimum intervention, mimicking of natural processes through small-scale thinning. • Retain all existing veteran trees and trees with decaying wood, opening up and pollarding to extend life span. • Aim for 40-100m^3ha^{-1} of deadwood ≥20cm diameter over a long time scale. • Identify and retain middle-aged trees (>20% of trees in stand) which might form a future generation of veteran trees - allow crowns to develop (see Forbes and Clarke, 2000 for further guidance). • Injure or kill trees to promote future deadwood supply. • Retain all cut wood on site preferably scattered on the woodland floor. • Leave all fallen deadwood where it is to decay naturally.
ASNW (including long established secondary woodland) with low deadwood volumes and/or saproxylic diversity.	Low deadwood volumes as a result of continual management (e.g. coppice); lack of large mature deadwood habitat.	Permit surviving natural processes with a view to securing and expanding remnant/residual deadwood. Retain sufficient mature timber habitats to attract colonist species and provide a continuity of deadwood supply.	• Store some coppice to produce high forest coupled with measures to improve stand structural diversity. (Unless this has an adverse effect on species which depend on the open conditions of coppice and young growth stands, e.g. the Argent and Sable moth *Rheumaptera hastata*). • Concentrate provision of deadwood in older stands (>120 years). • Maintain at least 20-40m^3ha^{-1} of deadwood ≥20cm diameter. • Retain, open up and pollard any existing veteran trees. • Identify and retain potential veteran trees or trees with decaying wood (20% of trees in stand). • Retain 20-40% of all cut wood on site; leave all fallen deadwood if possible.
Plantations on Ancient Woodland Sites (PAWS).	Deadwood volumes may be high - i.e. vestiges of the previous native stand. Shading by conifers poses a threat to deadwood habitat and veteran trees, especially oak.	Secure and enhance existing deadwood habitat in conjunction with other restoration procedures (see Thompson *et al.*, in press).	• Where practical, restore gradually using a continuous cover system which will maintain semi-shaded woodland conditions. • Open up veteran trees and deadwood gradually by removing non-native trees. • Consider killing non-native trees *in situ* to increase deadwood. • See Thompson *et al.* in press for more guidance.
Plantations established in the 20th Century.	Lack of large mature deadwood habitat; high volume of small dimension deadwood. Lack of native tree species. Deadwood often heavily shaded.	Concentrate deadwood provision within a network of permanently wooded habitats (natural 'old-growth' reserves) covering at least 1% of the forest area by the end of the second conifer rotation. Increase deadwood provision generally throughout the forest.	• Locate natural 'old-growth' reserves (>60 years) near existing native woodland or within riparian zones; aim to retain 5-10% of mature stems in perpetuity with canopies freed to allow full crown development; aim for 5-10% of stems to be dead or contain significant decaying wood features equating to deadwood volumes of approximately 20–40m^3ha^{-1}. • Consider retaining groups (>30m diameter) of snags, logs and stumps possibly in association with live stems, native trees species, small pockets of semi-natural vegetation etc. within felling coupes and in other stands (e.g. stands to be managed under a 'continous cover' regime).

Native pinewoods and long-established pine plantations in the Scottish Highlands

A male Capercaillie in pinewood undergrowth.

Crested tits depend on deadwood for nest sites.

Deadwood within native pinewoods and old pine plantations is an extremely important habitat for a range of different species groups. Historically, management has reduced the amount of deadwood in many woods, and typical volumes range from 30-50m^3ha^{-1} in total for snags and logs. Records from the least disturbed remnants suggest that volumes in excess of 100m^3 might be getting close to a more natural level.

Snag volumes are generally higher than log volumes in native pinewoods. Typically, mature or 'granny' trees die *in situ*, creating the characteristic stag-headed trees, bleached white in the sun. These standing dead pines can take up to 80 years to rot and provide stable long-term habitat. Branches drop off over time, and eventually the snag topples over shattering into smaller pieces. More rarely, whole trees blow over creating larger logs. These tend to rot very slowly especially where the canopy keeps the trunk free of contact with the ground in the initial years. The canopy can provide some protection from grazing, and often patches of tree regeneration can be seen coming up within the confines of the crown 'skeleton'.

Timberman beetle, Aconthocinus aedilis.

Snags, logs, stumps and crevices in veteran pines (and occasionally alder, aspen and birch) provide niches for crustose lichens - the distinctive 'pin-head' lichen group (where the fruiting bodies are borne on the ends of small stalks) is a characteristic community of these habitats. The bright yellow *Chrysothrix* lichen community is often found associated with these pin-head lichens and can be an indicator of their presence. Stumps are also important for lichen species within the genera *Calicium* and *Cladonia*. A real rarity within this group is the scheduled species *Cladonia botrytes* the stump lichen.

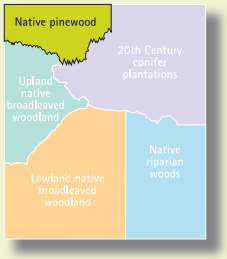
Cladonia botrytes the stump lichen - Simon Davey.

Deadwood in native pinewoods is very important for invertebrates many of which are restricted to the mature pine forest area in the Scottish Highlands. A range of saproxylic beetles depend on a continuity of supply of large diameter snags and logs, for example the timberman beetle *Aconthocinus aedilis* (left) an early colonist of new deadwood. Rot holes in stumps are important for the larvae of the rare hoverfly *Blera fallax*. Another hoverfly *Callicera rufa* prefers rot holes and crevices in standing pine. Recent research has also highlighted the value of deadwood for birds, such as the crested tit *Paris cristatus* which nests in well-decayed snags and stumps >30cm in diameter. Other species such as wryneck *Jynx torquilla* nest in old woodpecker holes in snags, and capercaillie *Tetrao urogallus* roost in large dead branches.

It is not just pine which yields important deadwood. Broadleaves within native pinewood such as birch, willow and aspen also provide key habitats. Veteran aspen, for example supports a distinctive saproxylic ecosystem in its own right, a characteristic species being the hoverfly *Hammerschmidtia ferruginea*. Other habitats include bog woodlands where stunted pine, birch and juniper form a distinctive feature and provide habitat for beetles such as *Leptura sanginolenta*. Fallen trees are also important in streams, ponds and other water features.

Most native pinewoods are likely to be managed at a low intensity in the future so natural processes of death and decay should ensure the provision of deadwood habitats. However, opportunities exist to augment the supply of deadwood, particularly in long-established pine plantations where stem densities are in the region of 200-400 per ha. Measures include:

- Injuring and ring barking mature trees (diameters >30cm) or removing crowns.
- Leaving large fallen deadwood and stumps.
- Creating high stumps (minimum of 10 per ha in clusters, cut at about 1-3m high) to benefit hole-nesting birds.



Native pinewoods and long-established pine plantations in the Scottish Highlands

KEY TO ILLUSTRATION

1 Actively eroding scree slope generates deadwood.

2 Standing dead and dying pines provide a stable long-term habitat.

3 Capercaille and osprey roost in large dead branches.

4 'Bog woodland' contains stunted veteran juniper and pine - a key species is a longhorn beetle - *Leptura sanguinolenta*.

5 Weight of snow and ice in canopy breaks branches.

6 Hoverflies *Calicera rufa* and sawflies breed in crevices on standing dead pine.

7 Crested tits nest in well-decayed pine snags >30cm in diameter.

8 Pine snags provide an important habitat for 'pin-head' lichens *Chaenotheca* species.

9 Actively eroding river banks provide a good natural supply of fallen deadwood.

10 Logs bridging rivers form access routes for animals and hiding places for fish.

11 Seedlings regenerate within the dead branches of fallen pine.

12 The timberman beetle *Acanthocinus aedilis* is an early colonist of dead fallen pine - a host of other rare deadwood beetles inhabit well decayed fungal-infected wood.

13 Stumps have a rich lichen flora and provide rot holes for the larvae of the rare hoverfly *Blera fallax*.

14 Root plates provide a sheltered microclimate and allow seedlings to escape browsing.

15 Dead and dying aspen provides a unique deadwood ecosystem.

Upland broadleaved native woodland in the north and west of Britain

This woodland category includes Atlantic oakwoods, birchwoods and mixed ashwoods. Two main factors affecting the value of deadwood habitats which are common to all three woodland types are: 1) the occurrence of wood pasture; and 2) the east-west change in site types and climatic zones.

One of the distinguishing features of upland wood pasture appears to be the occurrence of widely spaced veteran trees which show some signs of having been managed on a more or less formal basis (e.g. pollarding), (Quelch 2000). The precise distribution and extent of upland wood pasture in Britain has not yet been determined, although it is probable that the best sites in the uplands for saproxylic species will have a history of wood pasture management.

Native broadleaved woodland which has been managed historically as high forest or coppice is generally lacking in deadwood, although the absence of management over the past 80-100 years in some woods appears to be allowing the accumulation of logs and snags through windthrow. In oakwoods, log volumes typically build up from snapping of large branches. In birchwoods, snapping of the main stem is more common leaving snags of varying height.

Recent surveys have revealed that in more continental climates in the eastern half of the country (Scotland in particular), dead oak timber can support those crustose lichens normally associated with Scots pine (see native pinewood section). In western oceanic climates, deadwood becomes much more important as a substrate for bryophytes. Many ancient woodland bryophytes need a constant regime of humidity and shade. In the wettest areas, liverworts such as species of the genus *Lejeunea* can form wefts over deadwood, cliffs and boulders. Well-decayed (i.e. where the bark has been lost, and the wood is beginning to break down) fallen deadwood appears to be the most valuable substrate for bryophytes. Particularly well-developed bryophyte communities on deadwood and veteran trees provide important cover for predatory beetle species such as the caterpillar hunter *Dendroxena quadrimaculata*.

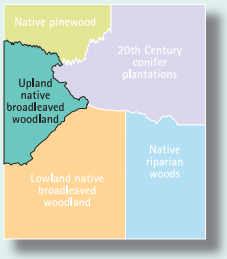
Birch is not as long-lived as oak, and the onset of dieback can occur as early as 80-100 years of age. On an ecological time scale therefore, birch can provide a form of 'instant' deadwood. Birch rots from the inside out creating hollow tubes of dead bark which in turn provide excellent roosting sites for bats. Bracket fungi *Fomes fomentarius* are also a distinctive feature of birch snags. Several moth species need over-mature or veteran birch trees, for example the Rannoch sprawler *Brachionycha nubeculosa*. Priorities for deadwood conservation in upland native broadleaved woodlands include:

- Establishing minimal intervention areas to allow natural processes a freer rein.
- Retaining all existing veteran trees and large diameter (≥20cm) deadwood.
- Encouraging the development of veteran trees of different native species.

Fallen logs provide a rich bryophyte habitat occasionally colonised by vascular plants such as wood sorrel Oxalis acetosella.

Pine marten running over a fallen log.

Bracket fungi on veteran birch.



Upland broadleaved native woodland in the north and west of Britain

KEY TO ILLUSTRATION

1 Veteran birches provide habitat for moths such as the Rannoch sprawler *Brachyionchya nubeculosa*, and for pine marten.

2 Birch is a short-lived tree and is a good source of 'instant deadwood'.

3 Birch rots from the inside creating hollow tubes of deadwood which provide roosts for bats and nest sites for hornets and woodpeckers; bracket fungi *Fomes fomentarius* are a distinctive feature.

4 Fallen logs are best left where they fall or stacked in partial shade.

5 Oak deadwood takes a long time to decay providing continuity of habitat over hundreds of years.

6 Debris dam affects river flow and stream morphology, creating valuable habitat diversity.

7 Polypody fern growing on large dying branches on mature oak.

8 Oak heartwood although hard and stable is broken down over time by fungi such as the beefsteak fungus *Fistulina hepatica*.

9 Active callousing in response to injury 'seals' in deadwood creating rot columns within trunks and branches of living trees.

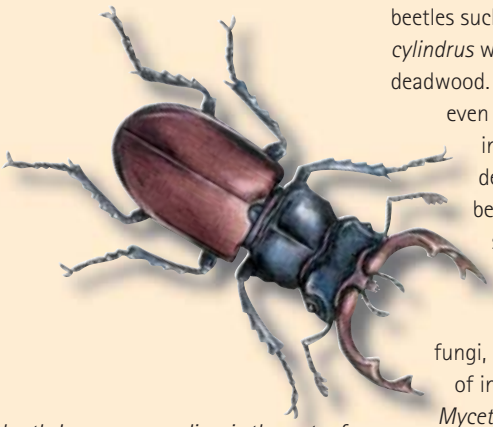
10 Burrs, epicormic shoots and rough bark complement deadwood habitats.

11 Upland oakwoods often contain a high biomass of fallen dead branches.

Lowland broadleaved woodland in the south and east of Britain

Top: Tree creeper nests in snags.

Dryad's saddle on beech log.



The stag beetle Lucanus cervus lives in the roots of deciduous tree stumps.

As with upland semi-natural woodland, lowland broadleaved woodland can be roughly divided into woods with high saproxylic species interest and those with lower interest. Lowland wood pasture (and parkland) is a key habitat for saproxylic species, and is characterised by large, open-grown (often pollarded) trees at various densities, in a matrix of grazed grassland or heathland. The particular value of lowland wood pasture for saproxylic species is attributable to a wide variety of different deadwood habitats intermingled with nectar-rich flower meadows and pastures. A number of rare and priority species are listed in the Habitat Action Plan for lowland wood pasture and parkland (UK Biodiversity Group, 1998) including amongst others, the Moccas beetle *Hypebaeus flavipes* and the New Forest parmelia *Parmelia minarum* (a lichen). Guidance on the creation and management of deadwood habitats and veteran trees within lowland wood pasture is covered in Read (1991), (1996) and (1999) and is not addressed specifically in this section.

In other types of lowland broadleaved woodland such as managed coppice and high forests, deadwood volumes were historically low, but after droughts and major storms in many woods in the 1980s and 1990s, volumes increased markedly. This lead to a rapid expansion in the range of some deadwood invertebrates notably beetles such as *Agrilus pannonicus* and *Platypus cylindrus* which are early colonists of fresh deadwood. It is safe to assume therefore that even in those woods which are quite poor in deadwood, artificially increasing deadwood habitats could considerably benefit more mobile elements of the saproxylic flora and fauna.

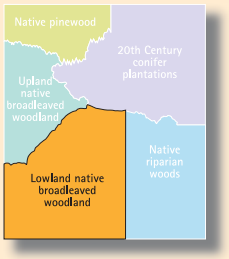
Both fallen and standing deadwood is very important for wood-decaying fungi, which in turn support a high diversity of invertebrates such as fungus gnats *Mycetophilidae*, mycophagous and predatory beetles. Wood-decaying fungi are mostly not specific to any particular tree species, although oak supports about 20 species specialising on stumps, trunks and branches. The well known beefsteak fungus *Fistulina hepatica* and dryad's saddle *Polyporus squamosus* are important colonists of heartwood of living trees.

Decaying wood habitats on living veteran trees are particularly important in lowland broadleaved woodland. Crevices and rot holes fill with detritus providing habitat for a huge range of invertebrates such as centipedes, scarce beetles (e.g. the lesser stag beetle *Dorcus parallelipipedus*) and wood lice. These invertebrates in turn provide food for birds such as the tree creeper *Certhia familiaris* and redstart *Pheonicurus phoenicurus*. Bats such as the noctule *Nyctalus noctula* are almost completely dependant on holes in dead trees for roost sites. Wounds and seepages (sap plus rainwater) provide feeding sites for hoverflies, hornets and butterflies. Deadwood is particularly important near glades and edges where open-structured flowers such as the umbellifers and hawthorns are of great importance as food sources for adults of insects whose larvae develop in deadwood.

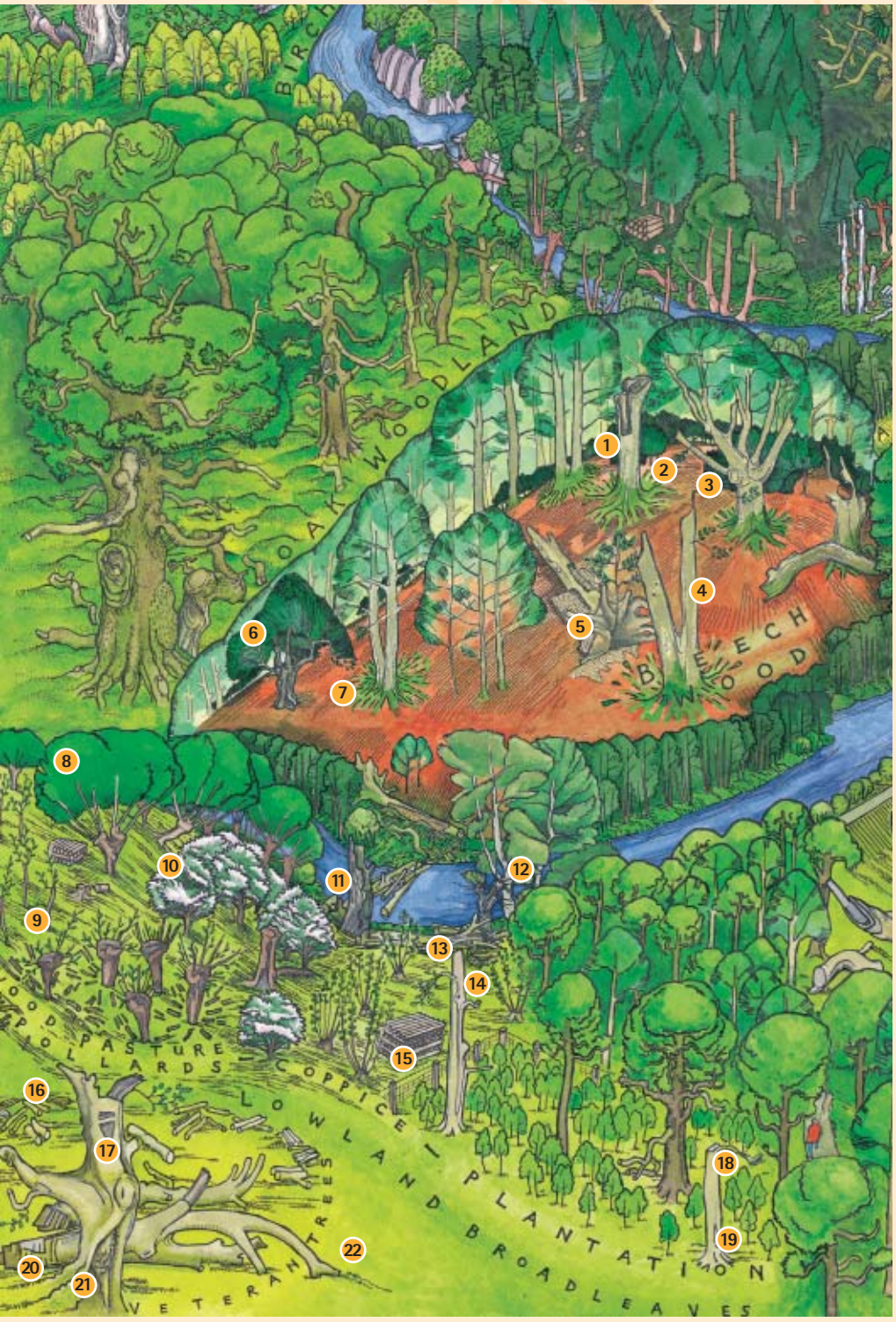
Key management priorities in lowland broadleaved woodlands include:

- Setting aside areas to foster development of old-growth conditions, especially new veteran trees.
- Pollarding existing veteran trees, creating wounds, crevices - cuts created by chainsaw can 'mimic' natural tears providing colonisation sites for deadwood species (although care should be taken not to damage natural crevices).
- Dead limbs can be as important as trunks for saproxylics, especially in beech - these should be left where fallen unless there is a significant risk to public safety; dead branches can also protect the sensitive rooting zone around veteran trees.
- Leaving fallen deadwood where it falls if at all possible. If deadwood has to be moved then it should be moved as short a distance as possible, preferably into dappled shade near rides or glades and near other deadwood, keeping it in contact with the ground. Piles of smaller logs are usually more valuable if lashed together or made into a 'Waterhouse' pile (see Read, 1999 for details).

Woodlice Porcellio scaber and other species live under fallen deadwood.



Lowland broadleaved woodland in the south and east of Britain



KEY TO ILLUSTRATION

1 Exit holes left by insects.

2 Insects and fungi depend on each other - insects breakdown the structure of deadwood, fungi cause chemical breakdown.

3 Rot hole created by pollarding creates deadwood habitat on a living tree.

4 Beech deadwood supports the widest range of insect species within lowland woodland.

5 Sapling regenerating on a root plate.

6 Cracks and rot holes in veteran holly provide food for tree creepers and nests for redstarts.

7 Below-ground deadwood provides a rich habitat for beetles.

8 Over-mature pollards brought carefully back into management.

9 Pollards with dead branches left on the tree; branches left on the ground protect the root zone from trampling.

10 Hawthorn is an important nectar source for deadwood species at certain points in their life cycle.

11 Decaying pollard containing detritus of leaves, insect and bird faeces and dead animals.

12 Willow pollard provides a temporary otter holt.

13 Raptor perch on dry beech snag.

14 Greater-spotted woodpecker hole.

15 'Waterhouse' log pile left in dappled shade.

16 Fallen deadwood is moister than standing deadwood and rots faster.

17 Bats like the noctule *Nyctalis noctula* roost in crevices and feed on deadwood invertebrates.

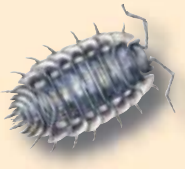
18 Loose bark creates cavities for centipedes and woodlouse.

19 Squirrel and deer damage.

20 Chainsaw cuts mimic natural tears and provide colonisation routes for deadwood species.

21 'Seeps' and wounds provide food for hoverflies, hornets and butterflies.

22 Large branches removed for safety.



Top: Bryophytes beginning to colonise a fallen spruce log.
Goshawk with chicks.

20th Century conifer plantations

This section focuses primarily on pine and spruce plantations, but the guidance is relevant to all types of upland and lowland conifer plantations established in the 20th Century. There is some value in spreading deadwood around the forest as whole (see strategy Table 1), but the quality of deadwood habitats is increased most effectively by focusing on a network of permanently wooded 'old-growth' reserves (Table 1).

Value of deadwood in old-growth natural reserves

These reserves can provide a semblance of old-growth habitat conditions, including large trees, structural diversity and deadwood. Conifer deadwood within these reserves can have significant value as a habitat for lower plants, fungi and invertebrates (Ferris and Humphrey *in press*). On the wetter site types in the north and west, large, well rotted logs (≥20cm diameter) within semi-shaded spruce stands provide an important habitat for bryophytes, mimicking in effect the value of this deadwood type in Atlantic oak - birchwoods. The Schedule 8 species green shield moss *Buxbaumia viridis* is part of this species group and is found on spruce logs in only a few sites in northern Scotland. In contrast to bryophytes, lichens prefer less shaded conditions and fare better in open stands on snags and stumps (particularly Scots pine). Again larger diameter material is more valuable, but not quite as well rotted as the bryophyte logs. Conifer deadwood (>10cm diameter) in streams and rivers can also add valuable habitat structure such as 'debris dams' which act as traps for leaf litter and other organic matter.

Windthrow is a source of deadwood in upland spruce.

Increasing fallen deadwood and stump volumes to 20–40m^3ha^{-1} will benefit wood-decaying fungi, particularly in lowland plantations. Wood decay fungi have an important relationship with deadwood invertebrates. To be able to utilise deadwood, wood-boring insects require wood infected by fungi as they lack enzymes to break down and digest uninfected wood. The combination of insects, fungi and rain produce water filled rot holes which provide breeding places for numerous flies and beetles; other invertebrates feed directly on fungi (see lowland broadleaved woodland section). Upturned root plates and large logs are also important prey 'plucking' sites for goshawks *Accipiter gentilis*.

Location of old-growth natural reserves

The location of these reserves is best considered at the landscape scale. Research suggests that the type of biodiversity developing in recent plantations is linked to the amount, and quality of semi-natural woodland present in the surrounding landscape. Conifer natural reserves and long-rotation stands should therefore be located adjacent or near to semi-natural woodland fragments, and also ideally in lower wind risk areas to allow trees to develop to full biological maturity. Where there is little or no native woodland present within the forest, the default position would be to locate old-growth reserves in the riparian zone, but within a mosaic of other open habitats and planted broadleaves, so that streams are not overly shaded. The design of these mosaics should not be identical for every riparian zone as there is also a need to encourage diversity at the landscape scale.

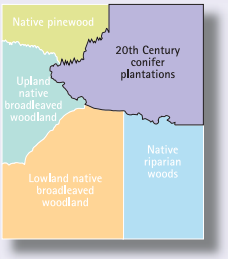
Size and management of old growth natural reserves

Old-growth reserves should ideally be 5ha or more in size to allow interior woodland conditions to develop, and could be linked to other long-rotation stands to provide additional buffering from disturbance. In the long-term, management inputs would be minimal to allow natural processes to generate deadwood. In the short -term some management may be needed to hasten younger stands in the mature stage (50-60 years) towards the old-growth stage. As the stand nears the age where death or disturbance will begin to break up the structure, variable density thinning can be adapted to hasten this development by opening up gaps and favouring healthy, windfirm stems that can be expected to survive for at least another 50-100 years. Any dead or dying trees should be left *in situ* (if safety considerations allow) with the aim of sustaining volumes of around 20-40m^3ha^{-1} of large diameter fallen and standing deadwood over the long-term. In riparian zones, old growth reserves should be located within at least 20m wide buffer areas to provide a continuity of deadwood supply to stream and river. These riparian old growth reserves should be managed by minimal intervention to reduce ground disturbance. (In streams which are subject to regular major flooding, there may be a need to securely anchor deadwood to prevent it being washed downstream where it may damage bridges and other structures).

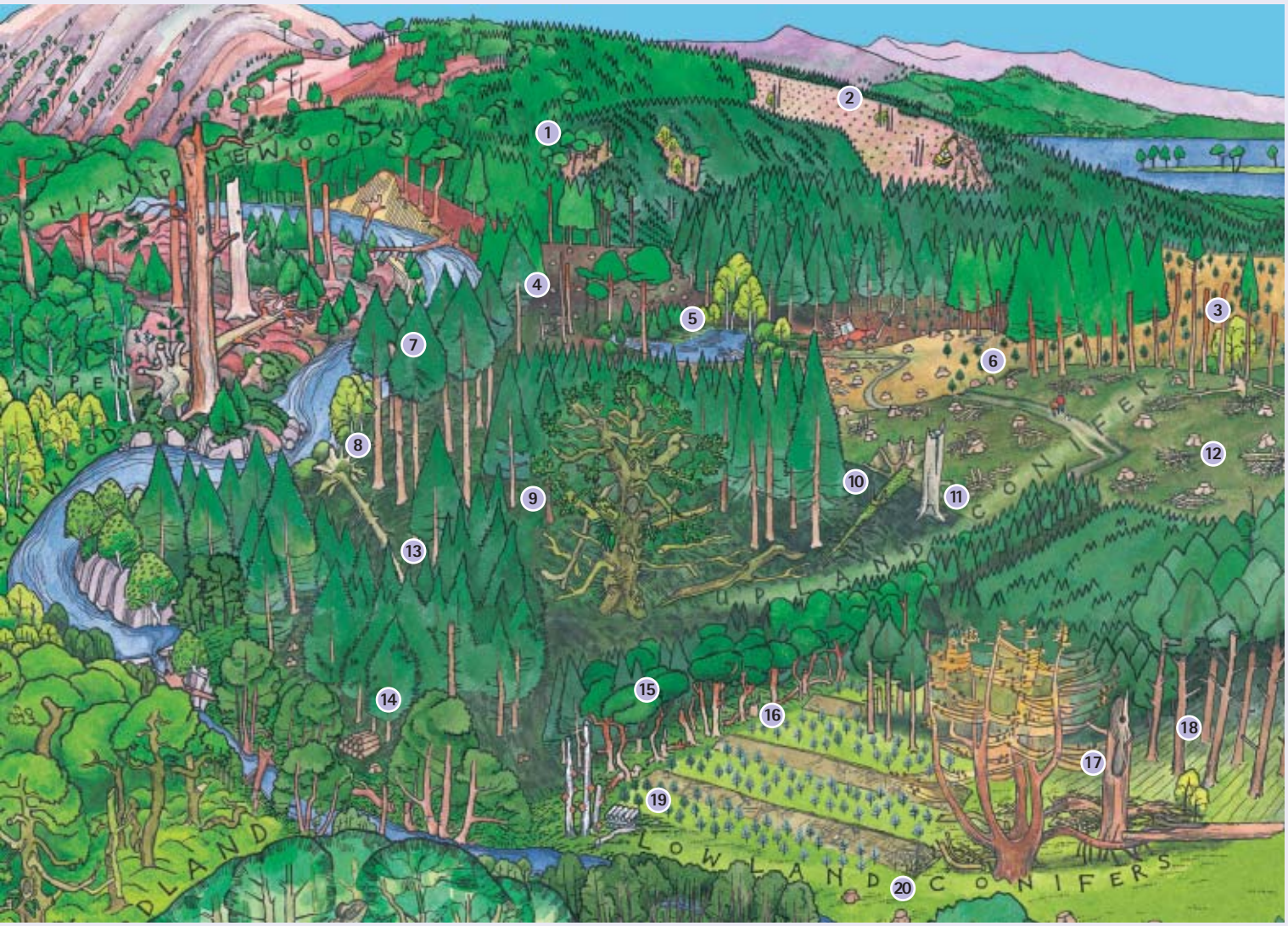
Felling coupe retentions and mid-successional stands

Harvesting residues on clear-fells, and thinnings in early and mid-successional stands are of value for maintaining continuity of habitat for generalist deadwood invertebrates (e.g. longhorn beetles), lichens and fungi. Leaving trees of poorer form as snags or downed timber will allow these components of the forest ecosystem to be retained through the rotation, particularly by targeting near old-growth reserves and native woodland fragments. Evidence suggests that deadwood should be congregated in groups rather than spread evenly over whole coupes. Patches of windthrow, large trees with poor form, broadleaves and/or Scots pine are desirable types of retentions on felling coupes. Aiming for patches greater than 30m in diameter is desirable, but not essential. Including patches with live retained trees will also help keep the deadwood moist. Fallen deadwood and coarse butts can also be stacked under the canopy of these patches. Patches make operational sense too, leaving the rest of the site clear for standard restocking.

The value, and hence the priority of having felling coupe retentions will vary regionally and by crop types. For example, within the 'native pinewood zone' in the Scottish Highlands, cut stumps on clear-fells are very important for lichens (*Cladonia* species), especially if allowed to rot in semi-open conditions. Therefore some stumps should be kept open during re-stocking. In lowland plantations such as Thetford, stumps left in piles after destumping (necessary for the control of butt rot fungus *Heterobasidion annosum*) can provide a habitat for adders *Vipera berus*, and perching posts for woodlarks *Lullula arborea*.



20th Century conifer plantations



KEY TO ILLUSTRATION

1 Retention within developing stand, combining maturing native trees, fallen and standing deadwood.

2 Snags provide raptor perches on clear-fells.

3 Retention on a felling coupe, combining maturing trees and deadwood: retentions >30m diameter are more valuable.

4 Retain cut snags.

5 Partially submerged deadwood in ponds and streams provides habitat for bryophytes and the larvae of craneflies (*Lipsothrix* species).

6 Stumps provide important niches for lichens (*Cladonia* species).

7 'Continuous cover' stands encourage structural diversity and deadwood accumulation.

8 Windthrow is an important source of deadwood and could be left uncleared in some stands.

9 Retain veteran native trees and open up surroundings within plantations on ancient woodland sites.

10 Retain large logs (≥20cm diameter) to benefit bryophytes e.g. the liverwort *Nowellia curvifolia*.

11 Retain snags (>2m high) - split with a chainsaw to mimic natural processes and improve value for hole-nesting birds.

12 Brash piles provide temporary shelter for invertebrates.

13 Locate old conifer 'natural reserves' near to semi-natural woodland.

14 Clear young dense conifers from riparian woodland: plan mosaic of open and wooded habitats retaining deadwood.

15 Permanent shelter belts provide continuity of deadwood and wildlife 'corridors'.

16 De-stumping removes below ground deadwood important for invertebrates.

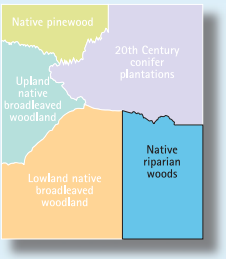
17 Small groups of veteran larch provide nesting sites for goshawks *Accipiter gentilis*.

18 Retain snags in stands as they mature.

19 Stump piles (created after de-stumping) provide shelter for adders and perches for woodlark.

20 Various species of clearwing moths use stumps for egg-laying.

life in the DEADWOOD



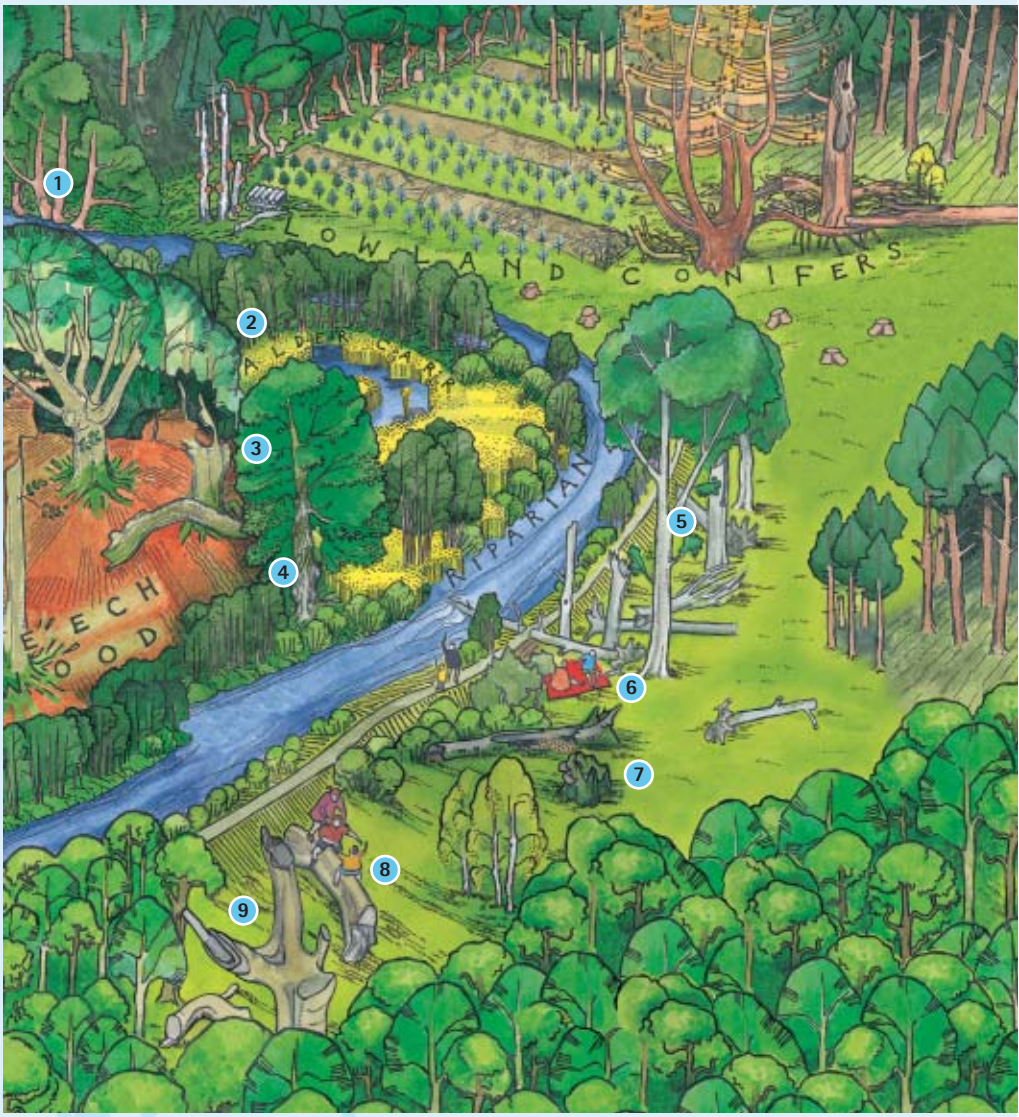
Native riparian woods

Native riparian woods

These are woods found in association with fresh water, beside streams, rivers, lochs and lakes, and are fundamentally important to the health and productivity of freshwater ecosystems as well as having conservation value in their own right. Fallen trees and deadwood play an important role in freshwater ecosystems by fostering the development of 'debris dams' which provide shelter for fish and trap organic matter. Wet rotting logs also provide an important substrate for rare cranefly larvae *Lipsothrix* spp. Veteran trees next to freshwater can provide nest cavities for birds such as goldeneye *Bucephala clangula* (in northern Britain), and burrows for fish to hide in amongst their roots. On most sites a non-interventionist approach is usually the best option for riparian woodlands to minimise disturbance and damage to stream sides and banks. However, pollarding can help to increase the value of old broadleaved trees for deadwood specialists; cavities can be created in trees close to freshwater to provide artificial nest sites. In lowland riparian woods, dead and dying poplar

Goldeneye nest in cavities in veteran trees

can add significant value, and should be left *in situ* to provide habitat for willow tit *Parus montanus*, lesser spotted woodpecker *Dendrocopos minor*, and invertebrates such as the lunar hornet clearwing moth *Sesia bembeciformis* [A full discussion of the benefits of woody debris in streams is given in Parrot and MacKenzie (2000)].



KEY TO ILLUSTRATION

1 Native riparian woodland including mature and overmature trees and deadwood.

2 Alder carr provides a good natural reserve and pollarding can provide a wetland source of deadwood.

3 Veteran trees next to freshwater provide nest cavities for birds and burrows for fish.

4 Retain rare black poplars in lowland riparian zones.

5 Allow dieback of non-native poplars to provide nest holes for willow tit *Parus moutanus*; lunar hornet clearwing moth *Sesia bembeciformis* larvae live in poplar stumps.

6 Recreation and amenity use should be planned to avoid safety problems from deadwood.

7 Nectar-rich plants in glades, rides and forest margins provide food for deadwood invertebrates.

8 Large log developed as an informal play and amenity resource.

9 Tree surgery stabilises deadwood in public places ensuring public safety and long term continuity in deadwood supply.

Planning

Beech logs provide important habitat for fungi.

How to go about planning a deadwood strategy at the local level

It is important to keep local deadwood management strategies simple and focused at the habitat and landscape scales rather than being based solely on individual species. The over-riding objective will be to initiate low maintenance systems which provide biological functions without excessive management inputs and costs. A separate plan for deadwood provision will not often be necessary as this can be included within other documents relating to wildlife and conservation planning, although locations of deadwood reserves should be recorded in design plans. Even if a separate deadwood plan is not needed, it is worth having a statement which summarises the approach to the management of deadwood. This should be simple and straightforward, so that it can be understood and used by operational staff perhaps after a modicum of training, and encourages a long-term perspective. It will take longer than we think to see a real change in the forest. The statement should include a number of elements, such as: setting out objectives and targets; identifying priority areas for deadwood within the forest as a whole (i.e. habitats known to have special value such as SSSI's), describing operations within these areas, and outlining plans for monitoring habitat development.

The deadwood management statement/plan needs to include:

1. Objectives such as:
   - To ensure that deadwood is provided where the biodiversity benefits will be greatest.
   - To ensure deadwood provision does not compromise safety.
   - To ensure that the provision of deadwood is adequately monitored.
2. Some simple policies for the normal working forest and some for the more special sites (using the information in Table 1).
3. Guidance on how the desired result will be achieved during normal forest operations. Questions that might be asked include:
   - What can be done at the site planning stage to identify opportunities?
   - How can machine operators be guided to look for existing deadwood, the opportunities to create more, and for ways of grouping deadwood with windfirm live trees?
   - What can be done with coarse low value logs or waste and where can these be kept moist?
   - Can anything be achieved during thinning and what safeguards are needed to protect the resource during felling or restocking? e.g. avoiding damage to existing deadwood from harvesting machinery.
   - What 'on-the job' training opportunities can be identified?
   - What type of monitoring is appropriate and affordable?
   - How should information be recorded and stored?

What the deadwood statement/plan does not need to include:

1. Complex stratification of site types beyond what is really useful. Keep it simple and combine similar situations.
2. Overly detailed prescriptions – encourage field staff to look for opportunities and for special sites.
3. Specification of minimum or absolute quantities except in very special cases. Lack of flexibility will lead to either inappropriate results on sites where few real opportunities exist or on others, opportunities being missed.

Minimising visual impact

Concerns over the visual intrusion of deadwood are usually over emphasised. Isolated snags can give a graveyard look but may in any case be of limited ecological value compared to snags that are bulked up into small groups with windfirm living trees, or broadleaf stands. As with any new activity, there may be a need for low cost interpretation in high access areas, briefly explaining what is going on and what the benefits for wildlife will be. For further guidance see Bell (1998) or seek advice from a local landscape architect.

Operational Management

Health and Safety

The risk of deadwood falling near people is generally low, but in areas which are subject to regular amenity or recreational use and adjacent to public roads, care should be taken to reduce risks by:

- Taking account of deadwood issues during the planning and management of timber operations. For example, an Environment Agency/Scottish Environmental Protection Agency licence may be required for work in a controlled water course.
- Developing a policy and methodology for the management of roadside trees (see Forest Enterprise Operational Guidance Note).
- Ensuring that dead limbs and trunks near recreational facilities are removed or stabilised. Where such hazards cannot be retained without compromising public safety only the minimum work should be undertaken to make it safe.
- Taking opportunities to use interpretation as a management tool to explain the hazards presented by deadwood.

For the manager, Site Risk Assessment will be the key in most situations (see Lonsdale, 2000; Read, 1999 and Ferris-Kaan *et al.*, 1993 for more guidance).

Tree health

There is a balance to be struck between the ultimate conservation value of deadwood and the shorter term risks of providing resources for bark and wood boring insects. Most bark beetles will not move onto living trees as they can only utilize stressed or newly dead trees. The exceptions are *Ips typographus* (not yet present in Britain) and *Dendroctonus micans* which can kill completely healthy trees. The switch to the colonisation of living trees only occurs after the beetles have built up in numbers in stressed or recently dead trees. This deadwood is only suitable for colonisation for a relatively short period (6 months). Once the bark has degraded sufficiently the tree becomes more suitable for colonisation by other invertebrates and fungal agents that together make up the more benign components of biodiversity. In the case of *Ips*, the risks are greatest in large forest blocks with contiguous areas of spruce that may be subject to windthrow and other environmental stresses. However, as long as *Ips* and *Dendroctonus* do not build up a significant population in British forests then risks to living trees of leaving increased amounts of deadwood should be minimal.

Treatment of stumps with urea

Recent research (Westlund and Nohrstedt, 2000) has shown that treatment of stumps with urea to reduce infection by *Heterobasidion annosum* can have damaging effects on plants and fungi surrounding the stump and also temporarily reduces the value of the cut surface of the stump as a substrate for fungi and other wood boring invertebrates. This is only a concern in long-established pine plantations and native pinewoods in the Scottish Highlands where stumps are an important habitat for rare species such as the stump lichen *Cladonia botrytes, Blera fellax* a pinewood hoverfly, and a host of other characteristic species. Stumps within these forests should not be treated with any fungal retarding chemical.

Monitoring and Recording

Monitoring of deadwood is essential to ensure that the objectives and targets set out within the deadwood management plan are being met. The type of monitoring system used will depend on the area of woodland under consideration and the resources available, but it should be sufficiently robust to clearly demonstrate changes over a long time scale. At the forest scale (100ha or more) the locations of key sites such as ancient semi-natural woodland, old-growth stands, felling coupe retentions etc. should be recorded, if possible within a GIS. This could be done as part of the forest design planning process. The sites would be re-mapped every 5 years with records made of any deadwood enhancement operations.

It should not be necessary to measure deadwood across the whole forest nor in all the key sites. A representative sample (10% of all key sites) measured on a 5-10 year rotation should be sufficient to identify broad trends. Ideally, deadwood should be measured, or at least estimated, quantitatively. The aim would be to sample 5-10% of the area of each stand/key site focusing on recording larger material (i.e. mid - diameter ≥ 20cm, length > 0.5m). The lower size limit for recording is usually 5cm diameter.

It is recommended that the line intercept method (Kirby *et al.*, 1998) is used for estimating volumes of fallen deadwood. This involves walking a line (transect) through the site along a set compass bearing, and counting the number of logs that intersect this line. Volumes can be calculated by estimating the mid-diameter and length of each piece of deadwood to the nearest 10cm, and placing within a size and a decay category. Normally, 10cm diameter size classes are used combined with a decay scale such as that shown in Table 2.

Table 2: Suggested scale for estimating decay state of deadwood, from Hunter (1990).

Index	Description
1	Bark intact, small branches present
2	Bark loose or sloughing off, no sapwood degradation
3	No bark, some sapwood degradation
4	No bark, considerable sapwood degradation
5	Sapwood and heartwood degradation

Standing deadwood and stumps can be measured in belts 2m wide on each side of the fallen deadwood transects. Only snags and stumps whose centres are within the belts should be recorded. As with fallen deadwood, height and diameter at breast height should be estimated for each deadwood item.

For a typical 10ha old-growth reserve, about twelve 100m transects would be needed to give a 5% sampling area; more transects would be needed in larger stands, and fewer in smaller stands. Care should be taken to ensure that the location of transects is stratified to encompass variability in stand conditions across the site. There should also be no bias in the starting point or orientation of the transects that might just include or just avoid a particular item of deadwood. Where exceptional accumulations of deadwood are encountered (e.g. catastrophic windthrow) it may be necessary, for safety reasons, to restart the transect on the other side of the windthrow and estimate the windthrown volume from a distance. All transect data should be stored on paper and ideally within an electronic database to allow comparisons between different sampling periods.

To identify new potential deadwood reserves, quick qualitative estimates of deadwood will be necessary followed up by quantitative assessments on those sites which are eventually selected. Aerial photographs will help identify areas of windblow, or the index in Table 3 could be used during a ground survey. Sites which had an index of 3 or 4 might be good candidates for deadwood reserves.

Table 3: Example of index for estimating value of site or stand in terms of snag/log densities (adapted from Peterken, unpublished). The index could also be used for other types of deadwood such as stumps or trees with decay columns, and heartrot etc.

Index	Description
1	Small snags/logs only
2	Large snags/logs at low density with our without small snags/logs
3	Large snags/logs at moderate density with our without small snags/logs
4	Large snags/logs at high density with our without small snags/logs

Small = 5-19cm diameter, < 0.5m length/height
Large = ≥20cm diameter, >0.5m length/height
Low density = 5% or less of total stems per ha (living + dead)
Moderate density = 6-10% of total stems per ha
High density = 11% or more of total stems per ha

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Leptura rubra a scarce longhorn beetle.

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life in the DEADWOOD

Glossary

Ancient woodland: Woodland which has remained uncleared since at least AD 1600 in England and Wales and AD 1750 in Scotland.

Bog woodland: Woodland containing a scattered mix of stunted trees, often of considerable age, and open bog vegetation.

Burr: A tumour-like swelling on a tree resulting from any number of causes, sometimes associated with epicormic (lateral branching from trunk) growth.

Carr: Water-logged woodland often on the edge of bogs or in other poorly drained locations.

Clearfelling: The cutting down of all trees on an area of more than 0.25ha.

Conservation Agency: Government agency responsible for the protection and conservation of the natural environment.

Continuous cover: Use of a silvicultural system whereby the forest canopy is maintained at one or more levels without clear felling.

Coppice: A tree or shrub repeatedly cut at, or close to, ground level.

Coppice stool: The part of a coppice which is left after cutting.

Coppicing: Cutting a coppice.

Crown: Spreading branches and foliage of a tree.

Debris dam: Accumulations of fallen deadwood of various sizes within streams which causes temporary but incomplete damming of water flow.

Decay columns: Columns of dead and dying wood within trees caused by fungal or bacterial infection.

Destumping: Practice of removing stumps after felling to reduce risk of spreading butt rot fungus to newly planted trees.

Felling coupe: An area proposed for felling in one operation.

FSC: Forest Stewardship Council.

Granny pine: Veteran native Scots pine tree with widely spreading branches and large girth.

Habitat Action Plan: Plans within the UK Biodiversity Action Plan which identify actions needed to stabilise and improve the status of habitats with high conservation value.

Habitat scale: Usually equated with stand scale (0.5 - 50ha) but can also include smaller areas depending on context.

Heart rot: Decay of inner wood (heartwood) of trees.

High forest: Woodland which is not managed as coppice or pollards and which may or may not be managed for timber.

Landscape scale: Areas greater than 1 km^2 - e.g. river catchments.

Log: Fallen deadwood.

Long-established woodland: Woodland planted in the 17th, 18th and 19th centuries; often managed using a non clear-fell silvicultural system.

Long rotation stands: Stands retained beyond the normal economic felling age (40-80 years), but which will be felled at some time.

Lower plants: Mosses, liverworts, and lichens

Mensuration: Measurement of trees.

Mid-successional stands: Stands which have passed the establishment phase, but are not ready to be felled; a typical range of ages would be 20-50 years.

Minimal intervention: Relating to stands where there is negligible management inputs, and practices such as felling, thinning and restocking do not take place.

Mycophagous: Organisms that feed on fungi.

Native species: Species which are considered to be naturally occurring in the UK.

Native woodland: Woodlands composed of site native and locally native tree and shrub species.

Natural disturbance: Disruption to forest stands, vegetation and wildlife by a natural event such as strong wind, fire or grazing.

Natural regeneration: Trees or shrubs which become established through the natural processes of seeding and germination.

Natural Reserve: Unmanaged stands set aside to allow natural processes a freer reign and to encourage the development of structural diversity and deadwood habitats.

NNR: National Nature Reserve designated by the country conservation agencies.

Old growth: A forest stand which has developed free from large-scale disturbance over a long period of time (80-500+ years) and contains large old trees, large fallen and standing deadwood in various states of decay, and a wide variation in tree size and spacing.

Open grown: The form of trees grown in the absence of competition and shading.

Parkland: Area enclosed for keeping deer and/or amenity use.

Plantations on Ancient Woodland Sites (PAWS): Planted woodlands of any type on Ancient Woodland sites.

Pollard: A tree cut 2-4m above ground level, producing a crop of branches which can be harvested in subsequent years.

Pollarding: Cutting a pollard.

Polypore: Fungal species within the family Polyporacea - includes bracket and fan fungi which live on deadwood.

Raptor: A bird of prey which kills with its feet.

Restocking: The practice of replanting after a stand of trees has been felled.

Restoration: The re-establishment of native trees and natural processes on planted ancient woodland sites.

Retention: Stand retained beyond normal economic felling age (40-80 years) which will normally remain unfelled in perpetuity.

Ride: Unplanted strips between stands, used as firebreaks and access routes.

Riffles: Rapids where the water is shallow and velocities high enough to keep the bottom clear of mud and silt.

Ring barking: Complete removal of a section of bark encompassing the full circumference of a tree trunk, done to kill the tree.

Riparian zone: Land immediately surrounding a watercourse.

SAC: Special Area for Conservation designated under the European Union Habitats and Species Directive 1992 (EC directive 92/43).

Saproxylic: Organisms that depend on wood, usually but not always dead wood, for some part of their life cycle.

Schedule 8 species: A species legally protected under Schedule 8 of the Wildlife & Countryside Act 1981. This means that neither the species nor its habitat should be damaged, nor the species collected in the wild.

Semi-natural woodland: Woodland containing native trees that were not originally planted.

Silviculture: The management of a stand of trees for pre-defined objectives.

Snag: Standing dead tree.

SSSI: Site of Special Scientific Interest - a designation given by the country conservation agencies under the Wildlife and Countryside Act 1981.

Staghead: Dead crown of a veteran tree.

Stand: A group of trees of similar age.

Structural diversity: Variability in the structure of forest stands attributable to tree size, shape, density and distribution.

UK Biodiversity Action Plan: The UK government response to the Convention on Biological Diversity at Rio de Janeiro; includes actions to safeguard key habitats and species.

UKWAS: UK Woodland Assurance Scheme.

Urea: Chemical used as a fungal retardant on stumps.

Variable density thinning: A thinning practice involving the removal of trees of varying sizes within a stand and at different densities throughout the stand.

Veteran trees: Fully grown trees which have suffered extensive dieback, with many branches lost or severely affected and with substantial heart rot.

'Waterhouse' pile: Log pile retained to benefit invertebrates.

Windfirm: Trees that are unlikely to blow over when exposed to strong winds.

Windthrow: Partial or complete overturning or breakage of trees.

Wood pasture: Grazed woodland characterised by open grown (often pollarded) veteran trees at various densities.

Forest Enterprise

An agency of the Forestry Commission

Further information and useful addresses

The Forestry Commission of Great Britain is the government department responsible for developing and implementing the Government's policies of sustainable forest management which include protecting and expanding Britain's forests and woodlands, and increasing their value to society and the environment. The Forestry Commission has national offices in Scotland, Wales and England. Contact the Forestry Commission for information on forestry and woodland management, grants and licences.

Forest Enterprise is an Agency of the Forestry Commission responsible for the management of forests and woodlands owned by the nation. Forest Enterprise became a Next Steps Executive Agency on 1 April 1996. Its aims are to deliver the environmental, financial, social and other outputs sought by Ministers and the Forestry Commissioners. Contact Forest Enterprise for information on Forestry Commission forests.

Forest Research is an Agency of the Forestry Commission and is the principal organisation in the UK engaged in forestry and tree related research. The Agency was launched on 1 April 1997 with the purpose of providing research, development, surveys and related services to the forest industry and providing authoritative advice in support of the development and implementation of the Government's forestry policies. Contact Forest Research for scientific advice relating to forest management.

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