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THE CONSERVATION MANAGEMENT OF DEADWOOD IN FORESTS

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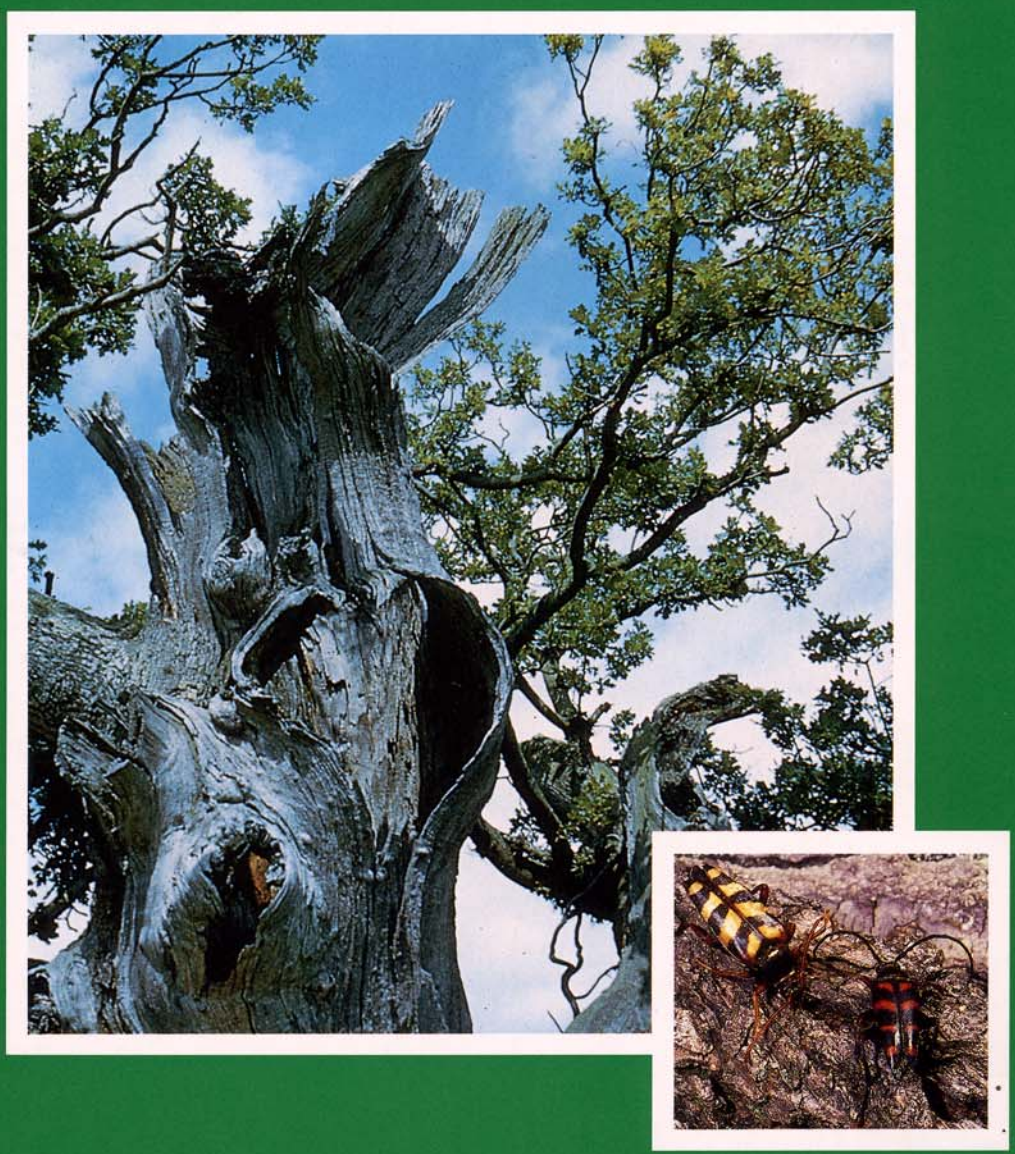


Abstract

Deadwood is an important component of the forest ecosystem, supporting a wide range of wildlife. Commercially managed forests may provide only a limited range of suitable deadwood habitats, but opportunities exist to maximise this resource through sympathetic management. This Note outlines the opportunities in relation to the main aspects of forest management and with reference to different types of deadwood habitat.

Introduction

Dying and dead wood is a valuable resource for a large proportion of the plant and animal species in forest ecosystems. It also represents part of the carbon and mineral store of the forest. In primeval forests, there is a balance between the decay rate of the existing deadwood resource and additions to it when trees die or undergo partial decay and branch shedding during life.

Accumulation of deadwood under the canopy or within the natural glades of an unmanaged forest may amount to 50–200 m^3 ha^{-1}, while in forests managed under a conventional planting and clearfelling cycle, the volume may be as low as 1–5 m^3 ha^{-1} (Albrecht, 1991). The variety of the deadwood resource also tends to be much diminished by such management.

Forest management, whatever its primary objective, can always be modified to enhance the quality and quantity of deadwood habitats. For high forests in which nature conservation is the primary objective, the aim should be to provide a similar quantity, quality and variety of deadwood to that found in 'natural' forests. Even in stands where most of the wood is destined for felling, sensitive management can ensure the existence of a valuable, though somewhat limited, deadwood resource. This applies to both commercial high forest and traditional coppice systems, where deadwood can be maintained on coupe margins.

Wood rotting fungi *play a vital role in forest ecology, including nutrient cycling. Species such as the sulphur polypore, Laetiporus sulphureus (left), decay wood and produce large fruiting bodies which have their own associated fauna.*

Front cover:
Over-mature trees provide a variety of habitats for wildlife.
Inset: Strangalia aurelenta, a scarce longhorn beetle and deadwood specialist.

The variety of deadwood habitats

Many categories of deadwood exist, and they vary greatly in the quality of habitat they provide for different kinds of wildlife. It is important that all types of dead material should be retained in reasonable quantity (Kirby, 1992), and it is therefore necessary to be able to recognise them. Deadwood quality is determined by several factors, including the tree species, the part of the tree concerned, the size of the deadwood units and the stage of decay. Local conditions are equally important, especially those influencing the moisture content of the wood and its exposure to sunlight.

Tree species

Native species which are large, long-lived and decay slowly, tend to support a greater diversity of organisms than non-native or short-lived species.

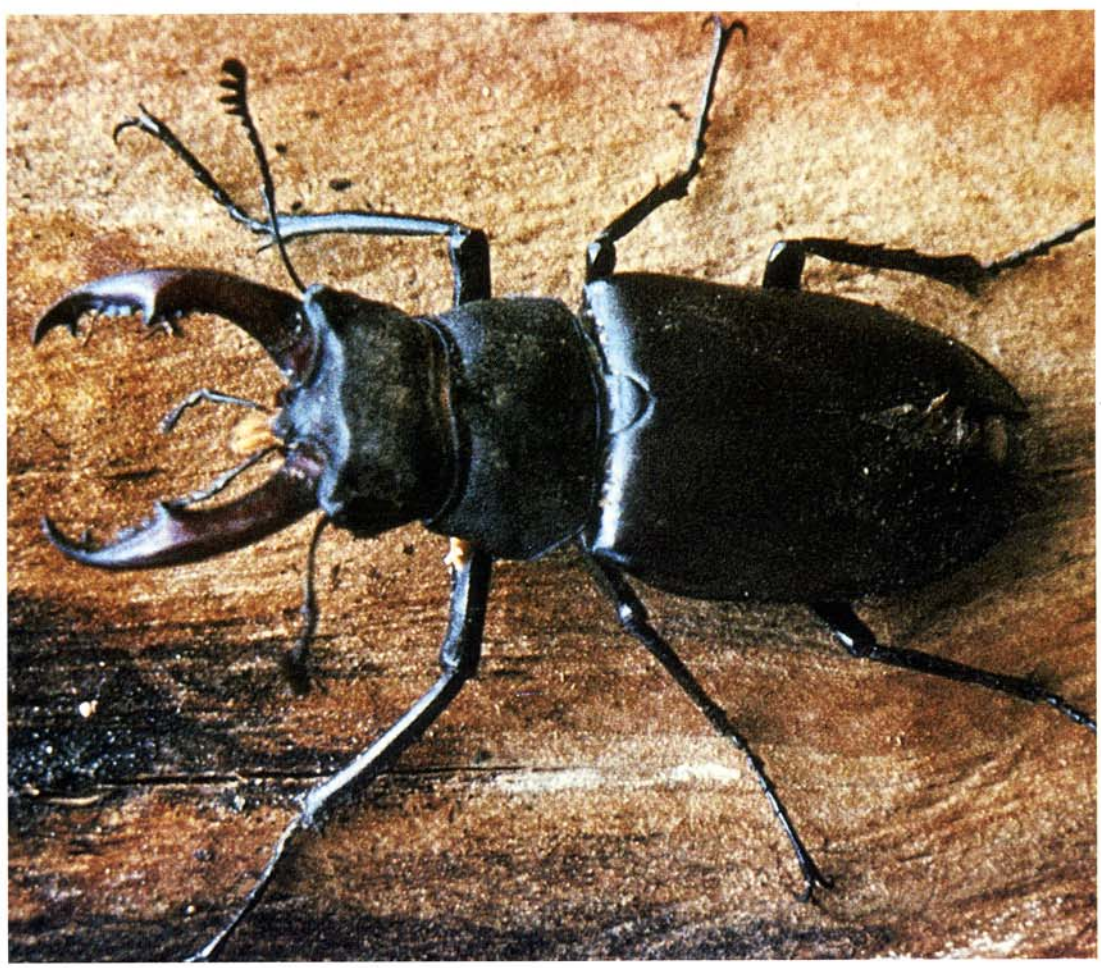
Of our native trees, oak (*Quercus* spp.) is the most important provider of deadwood due to its large size and slow decay rate. Its prolonged period of old age allows the development of many niches, supporting a diverse fauna. Beech (*Fagus sylvatica*), ash (*Fraxinus excelsior*), hornbeam (*Carpinus betulus*), elm (*Ulmus* spp.) and common lime (*Tilia x europaea*) are some of the other tree species which provide valuable deadwood habitats.

Birch (*Betula* spp.) may be seen as at the opposite end of the continuum from oak, since it is short-lived, with wood which decays rapidly once dead. It may provide deadwood and rot holes within 70 years, compared with a minimum of 100 years for oak, ash or beech. The fauna associated with dead and dying birch is of particular importance, especially in upland areas.

Native pinewoods (*Pinus sylvestris*) support a rich, specialised, invertebrate fauna, very different from that associated with broadleaved trees. To provide suitable niches for such organisms, a significant number of trees should be allowed to reach biological maturity, and die and decay *in situ*.

Size, position and decay pattern

Deadwood can vary in size from large trunks to small twigs; it may be high in the canopy or lying on the forest floor; it can be in sun or shade, in a wet or dry location; it can be standing or fallen, and it can be undergoing decay by any of a wide range of fungi. There is also an important distinction between decay that develops from the outside (mainly on fallen wood) and which provides a relatively short-term habitat, and internal decay (mainly in standing trees) which provides a habitat for several years, even centuries. From this almost infinite range, several categories of dead material can be recognised. The following list is not exhaustive, and should be treated only as a general guide.



Deadwood invertebrates: *up to a third of the woodland invertebrate fauna is dependent on deadwood. Beetles and flies are the largest and best known groups of saproxylic invertebrates. More than 200 species of fly occur in wood rot or sap runs. The spectacular stag beetle, Lucanus cervus, (right) is up to 66 mm long, and is just one of some 760 beetle species which use deadwood in Britain.*

- *Dead limbs on living trees*
  These may support a specialised range of invertebrates and fungi, as well as birds. Where limbs are exposed, such as on stag-headed trees, the extremes of temperature may lead to drying-out of the wood. This may cause the wood to harden, preventing penetration by some invertebrates. However, the hot, baked conditions often encountered in the summer provide a valuable niche for some solitary bees and wasps, which nest in the holes left by wood-boring beetles.

- *Decay columns in trunks and main branches*
  A very wide range of organisms are reliant upon such habitats, particularly if the tree as a whole is still alive. An especially valuable type of decay is 'red wood' in the centres of living broadleaved trees. It may be extensive in large ancient trees, but is not confined to these. Such heart rot can begin at an early age, and the tree may live for several hundred years as the rot progresses. Heart-rot fungi provide special breeding conditions for many rare species of invertebrate, especially beetles and flies. A high proportion of these, in particular flies, are associated with the fungal fruit bodies.

- *Rot holes in standing trees*
  Tree holes, formed by decay in the torn-out bases of branches or in crotches of main stems, often support a specialised fauna of beetles and flies. The initial injury provides access for pioneer fungi and invertebrates which can cause breakdown of the wood. If the result is a small rot cavity with moist wood debris it may be used, for example, by some soldier-fly species. Larger water-filled decay cavities and natural hollows may be colonised by other specialists including muscids and hoverflies; a number of fly species are known to breed only in tree holes.

- *Fallen deadwood: trunks and large branches*
  Depending on whether they are located in sun or shade, fallen logs support a range of different invertebrates and fungi, all contributing to the gradual humification of the wood. In addition to the species which may have colonised the tree while it was standing, there are numerous mites and springtails associated with deadwood on the ground. At the latter stages of rot in large logs, the secondary colonists enter through old beetle or fly galleries and crevices, and through holes formed by structural breakdown. Beetles, wasps and bumble-bees may hibernate in such material.

- *Fallen deadwood: small branches and twigs*
  Although generally of value to fewer species than larger material, small branches and twigs have an important part to play. They are often plentiful on the forest floor, and support some invertebrate species not found in larger material, including many mites and springtails.

- *Stumps and coppice stools*
  In addition to harbouring many of the organisms found in fallen deadwood, stumps have their own special flora and fauna, apparently with specific micro-habitat

Valuable flowering plants: *nectar-rich plants in sunny locations are important food sources for adult saproxylic invertebrates, such as the hover-fly, Criorhina berberina, (left). Plants such as hawthorn, rowan, bramble, ragwort and umbellifers (e.g. angelica, cow parsley and hogweed) will be rich sources of nectar throughout the summer. (Roger Key, English Nature)*

requirements. Stumps have a rich community of toadstools and brackets, and may provide a suitable substrate for both mosses and lichens, with their associated invertebrates. Stumps are a long-lasting and distinctive component of the forest floor.

Coppice stools, if cut tall, can hold a significant volume of deadwood, although well-managed coppice woods are rarely of great importance for deadwood conservation (Kirby, 1992). Precise information is sparse, although large coppice stools of ash are thought to provide a niche for the larvae of certain hoverflies (Fry and Lonsdale, 1991).

- *Deadwood in watercourses*
  Logs or branch debris which have fallen into watercourses can add valuable structural variation and alter flow characteristics of streams and rivers. Deadwood in watercourses is also a resource in its own right, being used as a refuge by opportunist species, as a feeding platform and as a source of food.

Associated features

In addition to deadwood itself, there are a number of other features of the forest ecosystem which are of value to deadwood specialists, especially invertebrates.

- *Sap runs*
  Live or partially decayed trees can have areas where sap oozes out for part or all of the growing season. Sap runs are mostly small and usually of little consequence to the tree. They can occur on trees of any species or age, but are commoner on older trees and are particularly frequent on firs (*Abies* spp.), elms (*Ulmus* spp.) and horse chestnut (*Aesculus hippocastanum*). Sap runs should be recognised as a positive conservation feature, since they can support an interesting and varied assemblage of invertebrates, composed chiefly of beetles and flies.
- *Nectar sources*
  During spring and summer, the adults of many deadwood invertebrate species rely on nearby sources of nectar. Open-structured flowers, such as those of umbellifers, composites and certain shrubs, are particularly important. Hawthorn (*Crataegus monogyna*) is the most important early summer nectar source, and the flowers of ivy (*Hedera helix*) are important late in the season, before hibernation.

Tree holes for birds: *deadwood is important as nest sites for many birds. The redstart, Phoenicurus, phoenicurus, (right), along with one third of all woodland birds, nests in holes or cavities in dead trees.*

Management systems

It is important to recognise situations in which deadwood conservation is a significant consideration.

Ancient and semi-natural woodland

Ancient and semi-natural woodland sites have a long history of woodland cover, usually 300 years or more. Such histories can be confirmed from old documents and by the presence of indicator species (Peterken, 1993). Many deadwood species depend on continuity of a rather narrow range of conditions. They cannot tolerate periods of modification by felling and replanting; neither can they persist when the deadwood supply has been reduced by traditional practices such as coppicing and gathering of firewood.

Wood pasture and parkland systems with ancient trees (especially pollards) are often particularly important sites for deadwood conservation. Because of the lack of disturbance and persistence of large trees, they often harbour particularly sensitive or rare invertebrates, lichens and fungi.

Mature plantations

Mature plantations often comprise numerous large trees, a patchy understorey and a relatively open canopy (Peterken *et al.*, 1992). Although younger than ancient and semi-natural woodland, these areas can provide habitats for many deadwood species. The vertical structure and patchiness of older forests is likely to be more varied than that of younger stands. If the tree species are native, the deadwood that they produce is more likely to support rare and specialised invertebrates. However, the structural value of deadwood of any tree species should not be under-estimated; it can provide suitable niches for hole-nesting birds and roosting bats. Extended rotation stands of broadleaved or coniferous trees can, therefore, become important sources of deadwood.

Roosting bats: *at least 10 of the 15 bat species found in Britain use tree holes for summer or winter roosts. Some species such as the noctule, Nyctalus noctula, (right) are almost completely dependent on holes in dead or decaying trees. (Frank Greenaway)*

Forest management practices

With careful planning, it is possible to integrate the conservation and provision of deadwood with forest management.

Planting

At the time of planting, plan to ensure the future of the deadwood resource. For instance, you could intermingle new plantings with older stands of native trees, which already have a reservoir of standing or fallen deadwood and associated organisms. In areas that have been largely deforested, always try to keep any groups of trees that remain, for example on inaccessible riparian strips or very steep terrain. In the absence of any such existing stands, earmark areas of newly planted trees for long-term retention, so that they can be a developing deadwood resource.

Felling

Take the opportunity to increase structural diversity and provide deadwood at felling time. By retaining live standing trees, snags (standing deadwood) and downed trees (fallen deadwood), preferably in groups, you can provide some ecological continuity between one forest stand and the next. It is not possible to recommend precisely what quantities of deadwood should be kept – current estimates suggest minimum densities of 6–8 mature trees, 6–8 snags, and 4–5 downed trees per hectare.

Destumping

In general, avoid stump removal; this applies equally to the stumps of trees uprooted in windthrow areas. They provide deadwood and other scarce habitats (Harding *et al.*, 1988). Leave some of them *in situ*, with a substantial length of stem attached to help stability. The root plates provide a valuable habitat, particularly for species of solitary bee which nest in tunnels in the dry and exposed soil. On some sites, water may fill the hollows left when large trees are uprooted, and thereby create valuable aquatic habitats. Sanitation destumping in cases of severe *Heterobasidion* butt rot is sometimes recommended; in general, removing deadwood for reasons of sanitation is based on an incorrect concept, and it can eliminate rare species of fungi and invertebrates.

Thinning

Thinning presents some possible conflicts with deadwood conservation. Since the aim is to improve the overall quality of the remaining crop, trees with poor stem form and defects are usually felled. However, such trees may develop valuable deadwood habitats, and so a proportion should be kept where possible. In addition, removing trees adjacent to a dead or decaying tree should be avoided because it may result in increased exposure to drying out.

Forest storage of products

If material from felling already shows signs of decay, it is best left scattered on site, under shade if possible. If it is necessary to remove some of this material to allow access, it should be stacked in the shade nearby. Log piles made from unsound and waste timber can provide a useful habitat and will eventually gather an interesting invertebrate community (Kirby, 1992). Log piles may be left along ride or roadside edges, in partial shade. This helps to prevent them drying out, and also provides deadwood habitats both in the sun and in the shade. The variety will attract a greater range of organisms.

Despite tradition, be aware that removing naturally accumulated deadwood for firewood can be very bad for deadwood organisms. Firewood piles should not be left in forest areas during spring and summer months. Many deadwood invertebrates emerge at this time, and the firewood piles may act as decoys, attracting organisms away from more permanent deadwood habitats. If leaving them is unavoidable, piles should be tented with a polythene sheet which is held away from the wood, to hasten its drying and prevent entry by invertebrates (Kirby, 1992). However, ensuring the presence of permanent alternative sources of deadwood will minimise the risk of deadwood invertebrates being distracted by decoys.

Hazardous trees

Managers have a duty of care for visitors to areas of forest under their authority. This extends to regular inspection and removal of dangerous trees or tree limbs beside car parks, picnic sites, public paths, roadsides or ride edges. The Occupiers' Liability Act (1957) lays down a duty for occupiers to take reasonable steps to ensure that premises (including woodland) are reasonably safe for visitors permitted to be there for any given purposes. The Occupiers' Liability Act (1984) allows for managers to contract with visitors in order to restrict their liability under the 1957 Act.

- Where a tree shows external signs of decay or structural weakness, the owner of the land on which it stands is normally liable for any damage it causes by breaking or falling.
- Trees in any of the above mentioned locations, especially those which are over-mature, should be inspected regularly. Annual inspections are best made in September or early October, when fresh fungal fruit bodies are most likely to be present. Immediate inspections should be made when trees are suspected of being in a dangerous condition. If this is confirmed, seek specialist guidance.
- Tree surgery can often reduce the risk posed to people and property by over-mature or decaying trees. If pruning of decaying branches is necessary, they should be kept as lying deadwood rather than removed from the site.

Further reading

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