Decaying Wood: An Overview of Its Status and Ecology in the United Kingdom and Continental Europe[1]

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Abstract

Decaying wood habitats are rare in Europe because of centuries of forestry and agricultural practices. Where there has been continuous woodland cover and within it an unbroken presence of old trees, the decaying wood communities are exceptional. The main woodland management systems operating in Europe are explained and how they influence the decaying wood component and associated wildlife. Priorities for conservation in a European context are outlined and selections of important old-growth sites are provided.

Introduction

Dead, or perhaps more accurately, decaying wood and much of the wildlife associated with it has become very rare in Europe. Any form of agriculture or forestry diverts natural resources from wildlife towards human activity (Fry and Lonsdale 1991), and our history is one in which timber and woody material have been removed from our woodlands. In traditional systems man would have utilized nearly every piece of wood. Today, dead trees are still cleared to make way for new tree crops; sanitation felling and burning is still practiced to protect lowland broadleaved forestry crops from a misguided perception of infection (Winter 1993); and a tidiness mentality overrides all. Mechanized operations encourage more intensive exploitation of timber produce and drive earlier and earlier returns on capital expenditure, reducing the age of standing tree crops and at the same time increasing the scope of sanitation and tidiness activities.

Intensive land use over the centuries and especially in the past 50 years has led to massive loss of a whole range of semi-natural habitats, and those that remain have become ever more isolated. Only a maximum of 10 percent of the land surface of most of Europe today remains in some more or less "semi-natural" condition (Speight 1987). In the United Kingdom (UK) nearly 50 percent of ancient woodland has been lost since 1947 (Fry and Lonsdale 1991). Between 1979 and 1990 there was a 14 percent loss of vegetation species richness in woodland—the highest for any

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habitat in the UK (Department of the Environment 1994). Because dead wood within existing semi-natural woodland is poorly represented, relic decaying wood communities have become more isolated than most.

Because the situation became more alarming, the Council of Europe (1988) adopted a recommendation on the protection of saproxylic organisms and their biotopes. This highlights that Europe is beginning to understand the importance of the decaying wood ecosystem. Since the 1990s, there has been a gradual change and the protection of decaying wood habitat is now cited as an environmental concern in forestry policy and procedures in many European countries.

Ancient Woodland

Ancient woodland is woodland that has existed since at least the 16th century on the same site, although it may have been managed throughout the centuries. Less than 2 percent of the land area of Britain is ancient woodland and mainly comprises small areas separated from each other by intensively managed landscapes; more than 8 out of 10 woodlands are less than 20 ha (50 acres). In many of these ancient woods there has always been woodland cover of one type or another that retains a continuity of habitat structure similar to the wild wood or virgin forest, which developed after the last ice age around 7,500 years ago. This continuity of woodland cover provides a habitat and biodiversity that is irreplaceable. However, in many cases the woodland often comprises young stands of trees. In ancient woods containing old trees and where there has been a continuous presence of old trees on the site, i.e., old-growth woodland, additional assemblages of rare wood-decaying species can be found.

Wood Pasture

Wood pastures are extensively grazed, open-structured woodlands that allow the regeneration of open grown trees, especially shade intolerant species. Trees in these open conditions have a much shorter, stockier stature as they achieve a full canopy without needing great height. As they age they become hollow, and the canopy may reduce further. Often there has been a tradition of pollarding the trees—regular cutting of the trees at head height or higher on rotation—for a renewable source of wood that has been very beneficial for the creation of decaying heartwood. The old trees are very important for decaying wood communities. Wood pastures are very vulnerable to intensification of use—changes that increase productivity of grass and overgrazing, which results in trees that are severely affected by high chemical inputs from fertilizers, pesticides and animal drugs, compaction, and water logging (Alexander and others 1996, Read 2000). This more open type of habitat is also particularly vulnerable to external influences, such as spray drift and air pollution from surrounding intensive grazing and arable production systems. British wood pastures and parkland are more common than in mainland northwest Europe probably because there has been a continuity of land ownership by the aristocracy who used wood pasture and parkland for deer hunting.

Coppice Woodland

By the Middle Ages, the typical management for coppice resulted in widely spaced trees that grew to maturity. Because of frequent harvest on short rotations of

the wood resource through the centuries, this woodland is most likely to have low quantities and a limited dead and decaying wood structure. However, old coppice stools, which survive and increase in size and age through many harvesting cycles, provide continuity of dead wood habitat. The old stools are known to be especially valuable for saproxylic hoverflies and other Diptera that favor decay in moist situations.

High Forest

By 1980, 75 percent of UK broadleaved woodland was managed as high forest (Hart 1994). Although accumulation of decaying wood in unmanaged woodland may amount to 50-200 cu m per hectare, in conventional high forest managed systems it may well be as low as 1-5 cu m per ha, and the variety of the dead wood resource tends to be much diminished by such management (Ferris-Kaan and others 1993). Many European countries are increasing the areas of minimum intervention woodland—that are largely untouched by people except to combat unwanted human influences. This should allow decaying wood levels to rise within them once again.

Wet Woodland

Wet woodland, such as Atlantic or oceanic woodland—which is characterized by cool, wet climate with few temperature extremes or woodland with wet features such as springs, streams, or rivers—can be especially important. This habitat supports humidity-demanding dead and decaying wood species, which are now very rare in Europe, and many of those that remain have been badly degraded by overgrazing (Hodgetts 1996).

Comparisons with Continental Europe

In much of continental Europe, forests generally are young high forest stands of trees, as wood is still a major source of fuel for local communities; whereas in Britain, coal, natural gas, and nuclear fuels have provided significant alternatives for centuries. The UK has more old trees in ancient woodland, wood pasture sites, and traditional agricultural landscapes than most other northern European countries (Green 1994). These ancient sites with existing old trees and shrubs contain characteristic dead and decaying wood communities, especially fungi, lichens and invertebrates. Because some of the trees can be more than 1,000 years old and many more than 500 years old, only a small number of generations have spanned the period between the last Ice Age and today (Key, pers. comm.).

Decaying Wood and Its Wildlife

Dead wood has a limited existence: it decays and is ultimately recycled. Conservation of wood decay communities requires conservation of a diverse age structure of living trees to senility and death because the living tissues generate the wood, which will ultimately decay. A continuity of different wood decay habitats in individual trees, above- and belowground and a variety of standing and fallen wood in different environments in woodland is therefore necessary to ensure sustainable wood decay communities.

The most important wood decay resources are large, old, standing, living and dying trees that develop columns of decay in the dead heartwood or center of the tree. Fungi are fundamental to the decay process.

Fungi

"A tree (or woodland) without fungi is like a stage without actors. For, throughout its life a tree generates a mobile wooden framework upon and within which literally countless fungi enact diverse ecological roles. Whereas some fungi bring resources to the tree others degrade and recycle its products" (Rayner 1996).

In Europe, "fungi do not figure in the usual brief for wildlife or habitat conservation. No voice has been raised on their behalf. They, however,… stoke the power plant of the forest. The more substantial the vegetation, the greater the variety of fungi for its degradation" (Corner 1994).

In the UK the role and importance of fungi in the wood decay system and in habitats generally is only starting to be recognized. Despite their importance at the center of woodland ecology, they have been largely overlooked and dismissed. Very old trees are exceptionally valuable for fungi, and the fact that the trees have reached an advanced age at all may be largely due to their relationship with fungi.

White rotted heartwood and brown rotted heartwood are produced as a result of non-pathogenic fungi digesting the principle wood components–lignin or cellulose, respectively. It is this decay process that creates the succession of decaying wood habitats that other species can exploit. Various other fungi can decompose or naturally prune the aerial parts of the trees in site; however, frequently different soil-inhabiting, decomposition fungi colonize the wood when it falls to the ground. Belowground fungi are also present colonizing roots. Finally, the fungal mycelium or fruit bodies themselves can provide specialist habitats for another community of invertebrates. The natural process of breakdown of dead wood releases valuable nutrients, which then can be recycled often via mycorrhizal fungi to living parts of the tree.

Invertebrates

About 6 percent of the entire British invertebrate fauna breed in or feed exclusively on other species that breed in decaying wood (Alexander 1999). This translates into 1,700 species with different lifestyles, since each species has very particular requirements. Very few invertebrates possess the necessary gut enzymes to break down the principle components of wood—cellulose and lignin—so most rely on fungi and other micro-organisms to convert them into something more edible.

In both brown and white heart rot, the end product is black wood mulch, which accumulates in the bottom of the hollow trunk as the fungi work into the upper trunk and main boughs. Fifteen percent of Britain's rarest insects, listed in the *British Red Data Book* (Shirt 1987), develop in this medium of relatively constant temperature and humidity, protected from the outside world by the surrounding living trunk tissues—for example, the click beetles *Lacon querceus* and *Ampedus cardinalis*. Specialist invertebrates also exploit the communities in and on the bark, including the epiphytic lichens.

Lichens

The most well-known epiphytic lower plant community is the *Lobarion pulmonariae*. *Lobarion*-rich parkland, with its well spaced ancient trees and a continuity of old trees, is of extreme importance for these and other lower plants; they are quantitatively richer and qualitatively different, holding a considerable number of epiphytic species confined, or nearly so, to such habitats (Rose 1991). Although lichens may not be confined to the largest or oldest trees, the presence of ancient trees in the area is the feature most strongly associated with lichen-rich stands. The *Lobarion pulmonariae* would be the climax epiphytic community in lowland Europe, but it has largely disappeared because of tree felling and pollution (Hodgetts 1996).

Lichens are key indicator species, demonstrating continuity of old trees on a site that is also well suited for fungi and saproxylic invertebrates.

Mammals and Birds

Some of the UK's most charismatic animals—woodpeckers, owls and bats—are associated with decaying wood habitat. These animals find opportunities for cavity nest sites in the dead wood and a wealth of invertebrate life in the food chain. Many are under severe threat in Western Europe—such as the Eurasian flying squirrel *(Pteromys volans)* and white backed woodpecker *(Dendrocopos leucotos)* (Spiridinov and Virkkala 1997)—due to the intensification of forestry practices and the effectiveness of sanitation felling.

Identifying Good Dead Wood Habitat: Demonstrating Continuity

Indexes of ecological continuity have been developed for lichens (Rose 1976) and saproxylic beetle fauna (Alexander 1988, Fowles and others 1999). Fungi representative of late stage successional habitats can provide further examples, although no index has yet been developed.

These indexes demonstrate that our priority is to perpetuate the continuity of wood decay habitats comprising old trees (both living and dead standing trees) on primary or ancient woodland sites.

Management for Decaying Wood in Europe

The wildwood of lowland Europe, in which wood-decaying communities were more frequent than today, comprised a mosaic of open sunlit glades, dappled by different densities of tree cover and dense high forest. It seems likely that there was a high proportion of woodland glades comprising low tree cover and dappled shade over extensive areas (Vera 1998). The glades would have been created initially by the role of fungi (Green 1996), sometimes in association with phytophagous insects and perhaps enlarged by other forces of wind, snow, fire, and erosion (Peterken 1996). However, in the UK the influence of fire and erosion is negligible (Rackham 1986). Once created they would have been kept open by browsing animals, many of which have long since disappeared from our woodlands (Dobson and Crawley 1994).

The priority in Europe is to identify and select areas of ancient old-growth or relic forest (Harding and Alexander 1994) and then maintain and perpetuate the continuity of old trees present on them. To perpetuate wood pastures, it is necessary to retain the remaining trees as long as possible, minimize damaging activities in their vicinity—for example, deep ploughing under the canopy of the trees—and promote the establishment of new stands of open-grown trees adjacent to existing stands or in close proximity (Alexander and others 1996).

It is also necessary to protect and enhance decaying wood in our semi-natural high forests and coppice woodlands by retaining far more variety and quantity of decaying wood habitats and especially to retain far more standing decaying trees of all ages. On these sites all fallen dead wood needs to be retained and "tidiness" discouraged. Equally as important is to ensure a sustainable provision of all types of decaying wood through the next millennium by retaining enough trees in each stand to become the decaying wood of the future.

The worst of all possible management scenarios is to burn the decaying wood (Green 1994, 1996). Along the Atlantic coast of northwest Europe, fire is not a natural part of the ecosystem of broadleaved woodlands. As decaying wood habitat is recycled by a succession of specialized species within the community, fire would seriously compromise natural processes.

Climate change and the isolation of habitats by intensification of land use will continue to have marked impacts on islands of biodiversity unless species populations have opportunities to develop and expand. Although there is all too little knowledge of the rate with which communities can expand and recover given suitable habitat directly connected or nearby to it, it is clearly a priority to identify the remaining vestiges of habitat that have a well differentiated fauna or flora of saproxylic organisms; manage them effectively; and buffer, extend, and ultimately work towards connectivity between them.

A Selection of the Most Important Decaying Wood Sites in Europe

- The New Forest—A remarkable area of wood pasture and the largest of its type in southern England.
- The North Cotswolds—A large area of traditional agricultural landscape with ash *(Fraxinus excelsior)* pollards in southern England. This area is remarkable for its richness of saproxylic fungi and invertebrates that is only slowly being recognized.
- The Lake District—An extensive landscape of pollard trees with exceptional epiphytic communities in northern England.
- Windsor Great Park—A high number of very large, old oak *(Quercus robur)* trees near London in southern England, some of which are over 1,000 years old, in a variety of environments from minimum intervention high forest, wood pasture and parkland, and intensive arable cultivation. This is perhaps the largest concentration of very old oak trees in the world in association with one of the highest indexes of continuity of saproxylic beetles and fungi in the UK.

- Fontainbleau Forest—Small areas of minimum intervention woodland in the midst of a large commercial and recreation forest by European standards, located southeast of Paris, France.
- Bialowieza National Park—The largest area of minimum intervention forest in Europe, 10,502 ha with some remnant old growth areas, located in eastern Poland.
- Island of Vilm—Former pasture woodland with no clearcutting since the 16th century. Nature reserve with old oak *(Quercus robur)* and beech *(Fagus sylvatica)* trees, located near the island of Ruegen, northeastern Germany.
- Bjärka-Säby—Larger oak *(Quercus robur)* woodland meadows now pastured by cattle, located South of Linköping, southeastern Sweden.

Glossary

Ancient woodland: Woodland that has existed continuously on the site since AD 1600 and has been cut only for under wood or timber production.

Semi-natural ancient woodland: Stands of ancient woodland comprised of mainly native species growing where their presence is apparently natural and not obviously planted.

Ancient replanted woodland: Ancient woodland sites with obviously planted woodland of a broadleaved, mixed or coniferous type.

Old-growth forest: [UK] Stands with more than 200 years' growth (Peterken 1996). Rose (1992) stresses the importance of continuity of trees older than 200 years.

Wood pastures and parkland: Historic land management systems that represent vegetation structure rather than a plant community and increasingly thought to mimic the structure of the natural forest before human activity. Typically this structure consists of large open-grown or high forest trees (often pollards) at various densities, in a matrix of grazed grassland, heath land and/or woodland floras.

Coppice: Trees cut regularly near the ground usually in rotation to produce a supply of small wood of small diameter for poles, stakes, and firewood. Usually grown with scattered trees allowed to grow to maturity without being cut back.

Pollards: Trees cut regularly at 2.5-4.0 m above ground level. At this point new shoots grow to provide a supply of small wood. The advantage of pollarding is that the land under the trees can be used at the same time as pasture for animals or stock without the danger of the animals eating the new shoots.

Native species: Trees and shrubs that colonized Britain unaided by human activity before the land bridge with mainland Europe was broken.

Exotic species: Trees and shrubs introduced into the UK by human activity in increasing numbers after 1600.

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