DEFINING AND SURVEYING VETERAN AND ANCIENT TREES

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1 Factors influencing ancient status and veteran tree quality

1.1 Veteran trees and ancient trees are surveyed as individuals for recording their habitat value and as populations to establish their viability, rates of loss and to establish population sustainability. The term 'ancient tree' may be understood as an age classification to describe the stage when, after the loss of apical dominance, a tree passes beyond full maturity and the crown begins to shed redundant parts and accumulate dead wood. During this stage, the crown begins to reduce in size (crown retrenchment) and the current growth-ring area of woody tissue annual increment (CAI) eventually reduces, compared to earlier developmental stages in the trees growth (White, 1998).

1.2 Varying degrees of trunk hollowing may naturally occur in this ancient stage. The ancient stage is the final stage in the life of the tree (Read, 2000) and, where conditions are favourable, this phase can be the longest. As the ageing process continues, the tree is progressively colonised by fungi that change the nature and condition of wood material and dead and dysfunctional woody tissue accumulate. Natural damage and shedding of tree parts can, through the agency of wood decay fungi, lead to trunk hollowing, branch cavities, live stubs, shattered branch ends, loose bark, sap runs and a range of rot types. These attributes are habitat for many organisms and are known as 'veteran features'. The organs of saproxylic fungi (fruiting body, mycelia etc) may in turn be colonised, for example, by specialised invertebrates, so that as the tree ages this complex woody substrate held within a living sapwood envelope provides an increasing range of specialised niches for different organisms to colonise with diverse 'life-styles'. In this sense to the extent that the tree advances through the ageing process and develops extensive colonised saproxylic habitat, in the ancient stage it can, though merely an individual specimen, be regarded to be an ecosystem.

1.3 Colonising saproxylic invertebrates with limited powers of dispersal may only take possession of rot sites in very specific favourable circumstances. The greater the length of time a group of trees exists on a site, the greater the possibility for particular specialised and rare species to colonise dead wood substrate, itself a scarce habitat associated with the rarity that is the ancient tree. An extreme example of such specialism is the endangered Moccas Beetle (*Hypebaeus flavipes*), a false soldier beetle, associated with ancient oak trees and only found at one site, Moccas Park in Herefordshire. Its rarity is sufficient for the beetle to be given special protection under Schedule 5 of the Wildlife and Countryside Act 1981 and identified as a priority species for protection in the UK Lowland Wood-pasture and Parkland Habitat UK Biodiversity Action Plan as *Endangered* in Great Britain.[1] Continuity and lack of disturbance is therefore a major factor in biodiversity associated with old trees (Alexander, 1988 & 2004).

1.4 The term *veteran* has come to be virtually synonymous with *ancient* and tends to be used in a colloquial sense to describe both the age and condition of a tree. From a technical point of view there are significant differences between these terms,

[1] UK Biodiversity Action Plan

particularly from the point of view of the principles involved in veteran tree surveying.

1.5 A *veteran tree* has the connotation of a 'battle-scarred survivor'; a useful term, borrowing from and extending accessible anthropomorphic concepts to communicate an understanding of the condition of trees. English Nature launched the Veteran Trees Initiative[2] based on a general understanding of this term and its accessibility to both a generalist and specialist audiences. To the specialist however, *veteran* describes qualities associated with particular habitats in trees, (principally associated with dead wood) and colonising organisms. A *veteran tree* has *veteran features* (habitat). The term does not automatically indicate extreme age. From an arboricultural point of view, *ancient* is an age-class characterised by particular physiological processes and developmental stages. An ancient tree is one that is old for its species and, while all chronologically ancient trees have veteran features sufficient to qualify them as *veteran trees*, all veteran trees will not necessarily have entered into the *ancient* age class.

1.6 It has been recognised that the assemblages of colonising species that initially develop in association with veteran features, when relatively recently created, differ from those found in an ancient tree context. A key influence on the quality and value of tree related biodiversity is the fungal microbial communities that drive the wood decomposition process (Rayner, 1993). Other factors affecting faunal colonisation relate to tree population characteristics. Age structure, population density and qualities of open and closed growth are significant in this respect.

1.7 Site history is a particularly significant factor influencing habitat quality; a specific element of site history is associated with the continuity of the tree population. Studies have shown that there is a positive correlation between species richness of saproxylic fauna and historical continuity. This understanding has led to a system being developed for evaluating ecological continuity that attempts to assess the saproxylic beetle fauna (scored according to rarity and occurrence in old habitats) to inform the conservation value assessment of the site habitat (Alexander, 1988; 2004).

1.8 It is uncertain, whether, or over how long a period of time, species assemblages that have been to-date identified only with ancient trees, will colonise newly induced saproxylic habitat in trees. However, it is known from population ecology studies that the fragmentation of the spatial structure of habitats leads to decline in dependant colonising species and further, that when numbers of trees with suitable veteran features decline, dependant colonising populations can 'go extinct' (Ranius, 2002 and 2006). When saproxylic tree features form 'precociously' from catastrophic events, which endanger the viability of the tree this can lead to confusing conclusions where it is advanced that physiologically compromising a tree positively benefits dead wood ecology. In this respect management to support the longevity of the tree is an important contribution to the continuity of habitat.

1.9 Veteran features in trees may be created by intentional arboricultural treatment or they may occur as a consequence of environmental impacts, such as drought, storms and man-made damage, rather than as direct result of the natural ageing process. In traumatic circumstances enhancement of biodiversity value may be expected to be

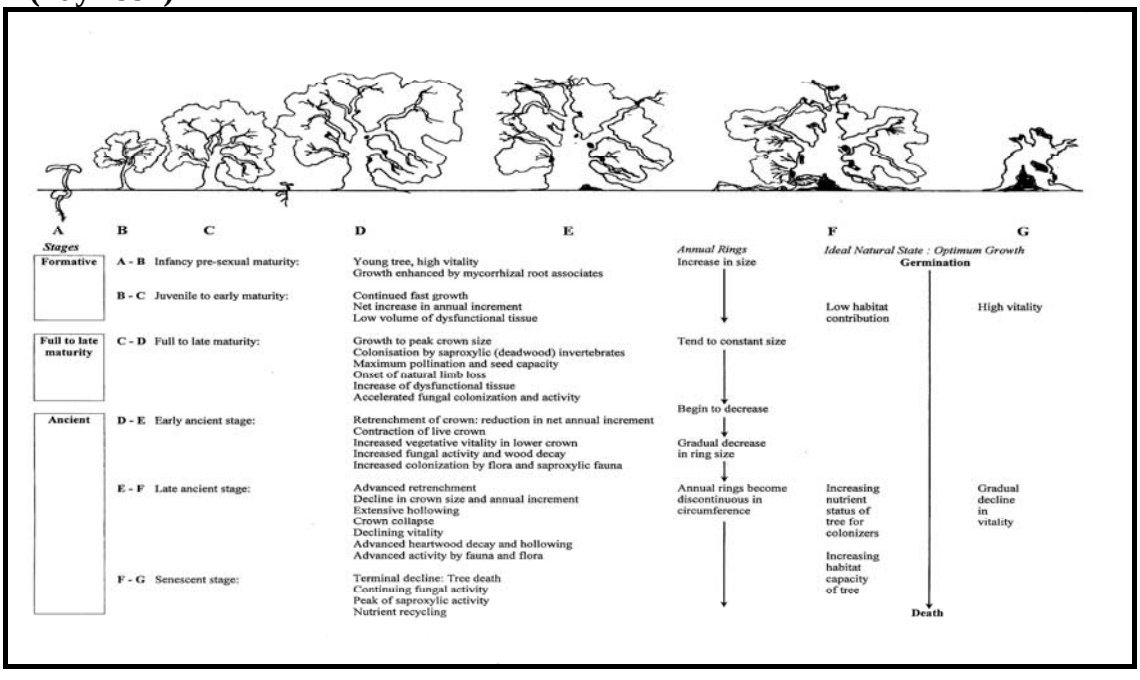
[2] The Veteran Trees Initiative was an English Nature project that took place between 1996 and 2000 to raise public and professional awareness about the importance of veteran and ancient trees and to produce publications and advance knowledge for their good management, conservation and protection.

limited in comparison to trees whose veteran features have developed naturally through an extensive, ageing process. The quality of such habitat therefore largely depends on the tree longevity and the stability of the associated context.

1.10 From a survey viewpoint a methodology has been developed to take account of these factors. This involves quantifying the number of veteran features according to the Specialist Survey Method (SSM) (Fay & de Berker, 1997), to determine the qualifying criteria for inclusion of what is a *true veteran*; i.e. a tree that is either ancient or mimics the quality and quantity of naturally developed veteran features typically observed in an ancient tree. Such trees have high saproxylic (veteran) quality. To account for the importance of habitat continuity in the tree population a technical distinction is made between *true veterans* and those that will in future be recruited into this sector of the tree population (see Figure B). These are *transition veterans;* i.e. trees that contribute to the veteran resource, show some of the features of a true veteran and, through the ageing process are expected to become true veterans, before which time they offer *bridge* and *continuity habitat*. Both these types of veterans have great significance in populations of trees for the continuity of dead wood habitat.

1.11 One of the main causes of veteran tree loss is branch, stem or root-plate failure. A key intention of any management strategy for the benefit of biodiversity is to enhance tree longevity where feasible by improving structural and physiological condition. Where failure is found to be a significant risk (*to the tree*), an element of remedial works is typically aimed at stabilization; often targeted to limited work on heavily loaded limbs. Where trees are considered to show signs of physiological stress or considered likely to be placed under stress, management may focus on promoting vitality: e.g. by reducing competition for light, improving the soil-root environment and/or pruning (where orchard trees are concerned this might be directed to pruning to reduce fruiting. Veteran tree management should be directed to enhancing tree longevity wherever possible to ensure that there is no avoidable loss of veteran and ancient trees (Fay, 2002).

Fig A: The Tree Ageing Process: From the perspective of developmental stages of a standard growing from seedling to death showing habitat (veteran) features (Fay 1997)



2 Survey methods: population studies used to classify age class and veteran status

2.1 When attempting to assess and monitor tree population dynamics it is essential that the age class of trees on the site is recorded. The site is walked and units divided, where applicable, according to compartments. However in some circumstances compartments were further divided in order to differentiate between wet woodland, oak woodland and parkland.

2.2 A walkover survey of age estimations for trees is usually based on diameter at breast height (dbh) using girth measurements (gbh) for controls. Different species have different forms and different rates of development; therefore it is necessary to have criteria for age classification to reflect these differences. Trees are recorded with respect to age class as *juvenile*, *semi-mature*, *mature*, *fully-mature* and *ancient*.

2.3 For the purposes of population surveys, trees are classified as juvenile if considered to be less than 20 years age. Similarly trees are classed as semi-mature if assessed to be between 20 and 60 years old. For the older age classes girth criteria shown in Table S1 is advocated. There are no guidelines for a satisfactory ratio of young, middle-aged and old trees in parklands, wood-pasture or orchards; however a varied age structure is obviously important for conservation and the continuity of ancient trees.

Table 1: The girth size categories used for age-class classification during both surveys

Age Class	Field maple, rowan, yew, birch, holly and other smaller tree species	Oaks, ash, Scot's pine, alder	Sycamore, lime, horse chestnut, sweet chestnut, elm species, poplar species, beech, willows, other pines and exotics
Mature	<2.0m	<3.5m	<4.0m
Fully-mature	2.0< & <2.5m	>3.5 & <4.0m	4.0< & <4.5m
Ancient	>2.5m	>4.0m	>4.5m

Table 2: Criteria for veteran tree identification: Veteran Tree Features
These are all based on the veteran tree recording methodology (SSM).

VeteranTree Features:	Description	Minimum Size
Rot sites	Rot sites associated with woumds which are decaying Following bark loas, wounding or limb loss wood may be colonised by fungi and other microorganisms. Rot is typically visible on the surface of the tree following bark disruption or damge. Rot sites may be apparent within the stem or branches or where a stem or branch has fractured and the wood become colonised by fungi. Such sites can then become important for a range of saproxylic species.	400cm^2
Holes & Water pockets	Holes and Water pockets in the trunk and mature crown Rot holes can develop through limb loss and bark wounds, and are expanded by digestive activity of microogranisms (particularly wood decay fungi) and invertebrates, and when inundated can form water pools. They can become occupied by invertebrates, mammals, reprtiles, birds and bats.	5cm - 15cm
Dead wood	Dead branhces or stems Dead wood may be fallen or remain attached. It is typically colonised by decay fungi and depending on its hydration, exposure, and elevation may support different suites of species. Extensive (Larger than 20cm in diameter) standing or fallen dead wood is of value.	15 cm diameter
Hollowing	Any hollowing in the trunk or major limbs.	See SSM
Fungal fruit bodies	Fruit bodies of fungi known to cause wood deacy	See SSM

Table 3: Veteran Classification according girth and habitat attributes

VETERAN CLASSIFICATION	Age Class	Qualifying Characteristics
TRUE VETERAN	Mature /Fully mature / Ancient	▪ Ancient tree (True Veteran): Identified primarilly by **qualifying girth size categories** used for age-class classification for survey purposes and/or qualifying phoenix properties (see Girth Table S1 & Age class - Veteran Status Fig S2) ▪ Non-ancient (True Veteran) Trees of any diameter that show **4 or more veteran features** of the above features have been These trees show the habitat characteristics of veteran trees that are thought to be important in terms of biodiversity.
TRANSITION VETERANS	Mature / Fully mature	Trees of any diameter that show **3 veteran features.** ▪ Transition veterans have some habitat characteristics and may become potentially important veteran trees for biodiversity in time. (see Girth Table S1 & Age class - Veteran Status Fig S2) ▪ These trees are important as bridge habitat in vulnerable, fragmented or widely scattered True Veteran populations.

Table 4 Veteran qualifying features (see SSM)

VeteranTree Feature:	Description	Minimum Size
Hollowing	Hollowing **Established trunk hollowing within a complete circumference is a most important indicator of a true veteran** and is very closely linked to the ageing process. Any hollowing in the trunk or major limbs is important though extensive trunk hollowing is indicative of a tree of great age for its species. Following the normal ageing process fungal decay may progress through the root system in the heart of the trunk and may form large cavities or become continuous creating an entire or partially enclosed cylinder. Such sites are extrmely rare when in an advanced state and the changing quality of the woody substrate amalgamtes into ever finer and 'soil-like' material (typically in ancient pollards). This latter stage indicates trees of great age and habitat of high conservation significance.	See SSM
Rot sites	Rot sites associated with woumds which are decaying Following bark loas, wounding or limb loss wood may be colonised by fungi and other microorganisms. Rot is typically visible on the surface of the tree following bark disruption or damge. Rot sites may be apparent within the stem or branches or where a stem or branch has fractured and the wood become colonised by fungi. Such sites can then become important for a range of saproxylic species.	400cm^2
Holes & Water pockets	Holes and Water pockets in the trunk and mature crown Rot holes can develop through limb loss and bark wounds, and are expanded by digestive activity of microogranisms (particularly wood decay fungi) and invertebrates, and when inundated can form water pools. They can become occupied by invertebrates, mammals, reprtiles, birds and bats.	5cm - 15cm
Dead wood	Dead branhces or stems Dead wood may be fallen or remain attached. It is typically colonised by decay fungi and depending on its hydration, exposure, and elevation may support different suites of species. Extensive (Larger than 20cm in diameter) standing or fallen dead wood is of value. Note: Dieback alone is not sufficient for inclusion in this survey as an indication of the presence of dead wood.	15 cm diameter
Tears, Scars, Lightning strikes	Tears, scars, lightning strikes result in exposed woody tissue Exposed woody tissue from bark loss associated with shedding limbs or lightning strikes may be vartiably compartmentalised. Tissue quality may be variable depending on extent, fungal decay activity, exposure and elevation on the tree.	30cm
Live stubs	Naturally fractured, truncated live stems or branches Live growth associated with fracture ends and shattered tissue creates a large surface area for microorganism colonisation. Such wound can be very variable in the type of habitat they offer for colonisation and can develop in hollow branches	15 cm diameter
Fungal fruit bodies	Fruit bodies of fungi typically associated with wood deacy	See SSM

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Non-ancient							Ancient		
Germination to Pre-sexual Maturity; Juvenile to Semi-mature: Mature: Fully-mature							Post Fully-maturity Onset of natural crown retrenchment (Fay 2002) Reduction in annual increment volume (White 1998) ↓		
Age Class	**Juvenile**	**Semi-Mature**	**Mature**		**Fully Mature**		**Early Ancient**	**Mid-Ancient**	**Late Ancient**
Reflects genetic inheritance of tree & its passage through developmental stages of the ageing process (Ontogenetic functioning / Controlled by meristematic tissues)	Seedling to end of first season End of first season to flowering onset. Early adult phase *up to* escape from loss of apical dominance. Annual-increment volume increases.		Early stage of escape from apical dominance. Onset of natural pruning. Relative increase in annual increment volume stabilises.		Onset of natural pruning. Incipient decline in annual-increment volume. At later stage of Fully Mature: development of *branch reiteration* (incipient independent branch functioning). *Start of retrenchment stage.*		*Loss of apical dominance. Rounded retrenched crown.* Proliferation of deadwood from redundancy. Decline in annual-incremental volume	Proliferation of re-iterative growth. Loss of under-branch vitality. Progressive hollowing in trunk & branches. *Longstanding hollowing is a rare and valuable saproxylic habitat.*	Outer crown mortality. Adventitious shoot & root growth. *Extensive hollowing throughout.* Discontinuous circumference. Branch/trunk reiterative growth channelled to root system - can break free (phoenix) from rest of system. Tendency to form multiple trees within parent ancient and to rejuvenation where favourable. Stage ends in decline/death or rejuvenation/phoenix regeneration.
VETERAN STATUS	**Non-veteran**		**Non-veteran**	**Elementary (Early) Veteran**	**Non-veteran**	**Inter-mediate (Early) Veteran**	**True (Ancient) Veteran**		
TRANSITION veteran For 'veteran features' refer to Specialist Survey Method, EN (1996)	—		—	**3 veteran features** &/or including **Phoenix trees** with *only regeneration evident*	—	**3 veteran features** &/or including **Phoenix trees** with *only regeneration evident*	Likely to have abundant veteran features: i.e. **4 or more veteran features** - Trunk hollowing is a key veteran feature potentially contributing rare habitat. - Ancients include trees of known antiquity and - *Phoenix trees:* either with significant proportion of ancient remnant parent tree in evidence or with evidence of ancient lineage identifiable through growth form (e.g. traceable layering &/or ancient coppice rings etc.).		
TRUE (-) Veteran	—		—	**4 or more veteran features**	—	**4 or more veteran features**			

Fig B: Age Class - Veteran Status: The relationship between tree age class, ancient trees and indicators of veteran status.

When assessing and modelling the age structure of a tree population, distinguishing 'elementary' from 'intermediate' veteran trees can contribute to understanding the sustainability of the numbers of trees in older age classes. Transition veterans include trees showing veteran habitat features corresponding to / mimicking those of ancient trees (i.e. at a pre-ancient stage). Ancient tree losses may be significant within a site as a whole or vary within a site. The value of transition veterans is that they contribute to 'bridge habitat' where there may be an age gap between pre-ancient and ancient trees or where the ancient age class is susceptible to significant losses. Given sufficient time and if such trees are viable, transition veterans contribute to saproxylic habitat and species continuity.

The ageing process is sometimes described as 'tree growth from seed to senescence': The term senescence presumes that the process of rejuvenation does not interrupt this ageing sequence with senescence describing a natural stage of physiological decline, the end result of which is death. However, many ancient trees display a range of *phoenix* survival strategies (including adventitious rooting, crown collapse and rooting, and trunk collapse followed by lateral secondary trunk formation etc). Some trees can repeat this process of phoenix regeneration many times giving the opportunity for assemblages of micro-organisms to be carried through many generations of phoenix succession. Trees capable of serial vegetative propagation in this way display a capacity for exceptional life expectancy and, in suitable circumstances, could have the capacity to live forever.