VETcert Species Groups/Guilds Associated with Veteran Trees Fact Sheet

Ancient and other veteran trees support many species that need the very special conditions that such trees provide. Many of these specialist species are already rare and becoming rarer still as we lose old trees and deadwood from our landscapes. It is vital that we retain and care for our veteran trees, even when they are dead, to ensure the survival of the species that depend upon them. It is also important that we understand the role that ancient and other veteran trees play in the complex web of life. They provide a rich and diverse range of habitats, playing host to countless other species. However, the relationships often work both ways; many of these species are crucial to the health of the trees.

In this document we want to give an overview of the species diversity associated with veteran trees. In no way is this document an attempt at making an exhaustive list of species. Neither does it give a value judgment to which species are considered important and which are considered less important. It is an overview of species from different guilds and different biogeographical regions, trying to inspire and stimulate veteran tree professionals to become acquainted with the biodiversity associated with veteran trees.

Fungi (wood-decay)

In recent years there has been a dramatic change in the way we look at relationships between fungi and trees. In particular, the hollowing of ancient trees by fungal decay, previously seen as detrimental, is now recognised as a natural part of the ageing process, which can even prolong the lives of trees. Fungi are also essential to much of the wider wildlife values of trees. It has been said that every tree provides a unique and dynamic support system for fungi, since almost the whole of every tree is associated with fungi. Certain kinds of fungi, which spread through woodlands below ground – can be extremely large – a honey fungus in the USA has been estimated as occupying an area over 3.5 km in diameter and weighing as much as 650 tons. With an estimated age between 1,900 and 8,650 years, this individual is an example of the great age that such fungi can reach, owing to their continuous growth habit. In principle, this could enable them to live forever, so that death for them is perhaps accidental rather than inevitable.

Fungal decay, often found in veteran trees, results in a diversity of micro-habitats suitable for other organisms. There are a huge range of species that are associated with trees, some are specialists (i.e. associated with a particular tree species or type of decay) and others are generalists. The mechanism by which wood-decay fungi decompose wood has an impact on the tree and on the species that then take advantage of the decayed wood. See the films with Lynne Boddy on www.vetcert.eu for more information and background.

Species	Habitat requirements
Fistulina hepatica	Heartrot fungus commonly found around the trunk or base of old, living oaks, where it decays the heartwood. It produces cubical brown rot, making the wood brittle by the very slow degradation of cellulose. In northern Europe, it is

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	almost exclusively found on oak, but in Central and Southern Europe it is not uncommon on sweet chestnut (Castanea sativa) and very rarely on other broadleaved trees (alder, birch, beech, hazel, lime and walnut). Each oak probably hosts a genetically unique individual. It produces annual soft and fleshy red fruit bodies. These are relatively short-lived, but the mycelium can be very old. A keystone species for many other species, in particular invertebrates.
Fomes fomentarius	Primarily found as a heartrotter on beech and birch, but can occur on many other tree species. It simultaneously degrades lignin and cellulose at similar rates and can be found on stumps, logs, living and dead standing trees. Forms a perennial bracket, often hoof-shaped, white to grey in colour. It forms a new pore-bearing layer each spring and can persist for many years.
Ganoderma spp.	There are several species of Ganoderma fungus and they can cause varying types of rot primarily of lignin, but sometimes simultaneous rot. The decay can also develop along the rays. They are found on many different broadleaved trees and even occasionally on conifers. The brackets are usually near the base of the trunk and main stem. G. applanatum/australe - relatively common and found on stumps, logs, standing trees. G. adspersum - is a southerly species (uncommon in Sweden and Denmark, where it is on the northern part of its range). It is found on beech, lime, elm and oak, but also spruce and pine to the north. Further south it can be found on the majority of broadleaved trees. G. lucidum - is quite rare and thought to a selective delignifier, with annual fruit bodies, often on oak, but also other broadleaved trees. G. pfeifferi - is quite rare, perennial fruit body, usually found on beech, rarely on oak. G. resinacuem - annual fruit body, mainly found on oak, but also other broadleaved trees.
Phellinus robustus	This is a species that is commonly found relatively high up on trees. It is generally associated with large, old branches and trunks of living and dead, usually old oaks, in open, often grazed habitats. Occasionally found on other species such as hazel and lilac. It is a white rotter and often fruits near to where branches have failed.
Laetiporus sulphureus	Heartrot fungus found on a range of broadleaves, particularly oak, but also conifers including yew. It decays

	the cellulose creating brown cubical rot and is a keystone species in terms of hollowing. Oak trees can survive with this species for centuries. It can be found on dead stem parts, hollows on living trees and heartwood. Forms a fleshy annual fruit body, which is bright orange or yellow.

Fungi (mycorrhizal)

Mycorrhizal fungi are crucial for the health of many tree species and their presence is often also an indication of healthy soil. They form symbiotic associations with the roots of trees and spread out into the surrounding soil, gathering mineral nutrients for the tree like an extension of the root system. They sometimes also protect roots from pathogens and from drought. In return, the tree provides a proportion of its carbohydrates, which it produces through photosynthesis. See the films with Lynne Boddy on www.vetcert.eu for more information and background. Ectomycorrhizal fungi (the species group that form visible fruiting bodies) are limited to a number of tree genera or species. Often the fungus species are tree species specific (associated to one or only a few tree species) and also related to tree age/life stage. Many other tree genera or species establish symbioses with endomycorrhizal fungi, which are less species specific and do not form visible fruiting bodies.

Species	**Habitat requirements**
Amethyst deceiver (*Laccaria amethystina*)	Species specific ectomycorrhizal fungus that is mainly associated with young roots of beech (*Fagus sylvatica*) and sometimes oak (*Quercus robur and petraea*) and hornbeam (*Carpinus betulus*) growing near beech trees, usually on sandy soils. It forms small purple coloured, gilled mushrooms, usually in the drip zone, where many young root tips of beech trees can be found. Near veteran beech trees, the fruiting bodies can often be found near the base of the tree, associated to young adventitious roots formed close to the stem base. Formation of these adventitious roots often concurs with partial dieback of the crown and heart rot or root rot. The ectomycorrhizal fungus then links the old beech tree to its offspring, germinating in the adventitious root zone surrounding its stem base.
Yellowdrop milkcap (*Lactarius chrysorrheus*)	Species specific ectomycorrhizal milkcap fungus that is mainly associated with roots of oaks (*Quercus spp.*) in deciduous forests and avenues on fairly humid and poor sandy or silty soils, which are low in lime. It forms pale salmon coloured, gilled mushrooms, that exudes milky latex that rapidly turns bright yellow (hence its name). Usually associated with mature and veteran oak trees, but can be found on younger trees as well.
Beautiful clavaria (*Ramaria formosa*)	Species specific ectomycorrhizal coral fungus that is mainly associated with the roots of oak (*Quercus spp.*) and beech

	(*Fagus sylvatica*) in old growth beech forests and avenues on poor to fairly nutrient rich (calcareous) soils. It forms pinkish coral like fruiting bodies with yellow tips. Usually associated with mature and veteran trees.
Orange spine (*Hydnellum aurantiacum*)	Species specific ectomycorrhizal tooth fungus that is associated with the roots of Scots pine (*Pinus sylvestris*) in open pine forests on very poor sandy soils. It forms funnel shaped fruiting bodies up to 15 cm, bright orange on top, with the spore bearing layer consisting of short, pale white teeth. Associated with old growth Scots pine on very poor soils.
Satan's bolete (*Rubroboletus satanas*)	Species specific ectomycorrhizal bolete fungus that is associated with the roots of old deciduous trees, mainly beech (*Fagus sylvatica*), sometimes oak (*Quercus robur and petraea*), in avenues on more or less poor, calcareous clay or sandy soils. It forms compact, hemispheric, white to pale grey caps up to 30 cm in diameter, later flattening. The stipe has a yellow base colour surrounded by a bright red mesh. Associated with veteran trees and old growth forests.

Epiphytes (e.g. lichens and mosses)

Well-lit surfaces of bare wood (exposed by damage) and of bark provide suitable surfaces for the growth of specialist plants and micro-organisms – mosses, liverworts, lichens, algae and micro-fungi. The gradual build-up of these epiphytic ('on the plant') species into recognisable communities is a very extended process of colonisation, growth and reproduction over decades and even centuries. Thus, the richest sites tend to be those with the oldest trees but species-richness depends also on local conditions, particularly sunlight, humidity and shelter. Owing to the need for sunlight, it is often the large old open-grown trees that support the richest epiphyte communities, rather than trees in closed-canopy woodland. Also, air pollution is a critically important negative factor, since it is poorly tolerated by most epiphytes.

During the slow development of epiphyte communities, there are changes in their species composition as they progress towards maximum diversity, as can be seen by comparing two year-old twigs, older branches and old trunks. Also, communities on smooth-barked trees are different to those on trees with heavily furrowed bark. The examples in the table below mainly grow on old trees and have in many countries been used as indicators of high biodiversity.

Species	**Habitat requirements**
Lobaria pulmonaria (lichen)	This mainly epiphytic species grows, in the majority of its European range, on old deciduous trees. In Atlantic

	climates it is less “picky” and can also be found on young trees and other substrates. Easy to recognise with its green leafy thallus.
Gyalecta ulmi (lichen)	*Gyalecta ulmi* is found throughout a large part of Europe and most often on old, deciduous trees, preferably with higher bark pH. Has decreased throughout its range as a consequence of loss of old trees, for example due to Dutch Elm Disease and Ash Dieback.
Porella platyphylla (moss)	This liverwort species forms lush green mats on trunks of old deciduous trees, often in shady and moist microclimates. Like many epiphytic mosses and liverworts it can also grow on rocks and boulders. Relatively common throughout Europe.
Neckera pennata (moss)	This moss species seems to prefer large tree trunks of deciduous trees, where it can form mats or large tufts. It is found in many parts of Europe but seems relatively rare throughout its whole range. In regions with large populations with old aspens (*Populus tremula*) it can however occur in numbers.
Basidia rosella (lichen)	This lichen species prefers old deciduous trees, often with a smoother bark, for example beech. It has a slightly odd distribution in Europe, spanning from Scandinavia all the way south to Italy, but apart from Spain and Cyprus, it seems not to occur neither east nor west of this axis.

Invertebrates (saproxylic beetles)

https://portals.iucn.org/library/sites/library/files/documents/RL-4-023.pdf

Saproxylic beetles are insects that depend on dead and decaying wood for at least part of their life cycle, and play important ecological roles in European habitats. Together with fungi, they contribute to the break-down of deadwood and are involved in decomposition processes and the recycling of nutrients in natural ecosystems. The exact number of saproxylic species is unknown, but a database of French saproxylic beetles includes 3,041 species. According to expert opinion, there may be closer to 4,000 saproxylic beetle species in Europe. Dead and decaying wood offer a large variety of microhabitats, and different saproxylic species have evolved to exploit these niches, with certain species having very specific ecological requirements. Some saproxylic beetles require live old trees with cavities for their larval development, while others are dependent on trees that have recently died. Saproxylic beetle richness depends on the quantity and quality of available dead and decaying wood in any environment with trees and woody shrubs, as well as on tree age structure, total number of trees, varying tree density, and habitat continuity. The assemblage of saproxylic beetles can be influenced by the degree of sun-exposure, frequency of habitat disturbance (i.e., forest fires or clear-cutting), hedgerow management, clearance of fallen deadwood from parks, age of tree stands and presence of certain types of wood-decaying fungi, among others. The long-term survival of these beetles depends on new generations of trees developing and becoming suitable for colonisation as the host trees decline and disintegrate. This means that certain beetles can be at risk even while the overall population

is strong, as new host trees are not becoming available. Old and hollow trees have become increasingly scarce around the world, including in Europe, due to land management practices.

Overall, 21.7% of species are considered threatened in the EU 27/28 respectively (IUCN, 2018). These values assume that a similar relative proportion of the Data Deficient (DD) species are likely to be threatened, and provides the best estimation of the proportion of threatened species. A large number of saproxylic beetles are dependent on ancient and veteran trees, especially those species developing in decaying heartwood and accumulations of wood mould in the resulting cavities. In Europe, large hollow trees have become increasingly rare due to land management procedures (e.g., logging, felling for health and safety reasons). Thus, the populations of saproxylic organisms associated with this microhabitat are undergoing a decline.

Species	**Habitat requirements**
Osmoderma eremita	Most commonly found in oak, but also other broadleaved trees. It develops in accumulations of wood mould in the stem of old trees and main branches with large cavities. This species is listed on Appendix II of the Bern Convention and Annex II and IV of the EU Habitats Directive. Larvae normally take two years to develop, longer where conditions are not optimal. The situation of the occupied hollow trees may vary across its European range, with open-grown trees important in the cooler and damper west, but with shading more important under more continental conditions. Oak Quercus spp. is the most important tree for O. eremita, followed by lime trees Tilia spp., willows Salix spp., beech Fagus sylvatica and fruit trees Prunus spp., Pyrus spp, and Malus spp. However, the tree species is less important than the fact that the trees have survived into old age and been colonised by non-pathogenic heartwood decay fungi; networks of trees are required in order to maintain population viability, to avoid the insidious effects of fragmentation and isolation. https://www.iucnredlist.org/species/15632/105873655
Rosalia alpina	This species is listed on Appendix II of the Bern Convention and Annex II and IV of the EU Habitats Directive. R. alpina has a plastic ecology in Europe. It is considered a montane species, associated with beech forests but the species is also able to colonise a variety of other deciduous tree species (i.e. Aceraceae, Betulaceae, Fagaceae, Oleaceae, Tiliaceae, Ulmaceae), from the coastline to about 2000 m a.s.l. At the landscape level, R. alpina

	prefers open and semi-open woodlands rather than forests. On a smaller scale, it shows a preference for mature, dead (or moribund) and sun-exposed trees occurring in open sites and/or in sites with a low percentage of canopy closure. Finally, the species prefers trees not surrounded by tall undergrowth which might impede flight. Additionally, trees occupied by R. alpina had, on average, thicker bark when compared to trees not occupied and they usually prefer trunks or branches at least 20 cm thick with dry or decomposing wood. https://www.iucnredlist.org/species/19743/9009447
Cerambyx cerdo	This species is listed on Appendix II of the Bern Convention and Annex II and IV of the EU Habitats Directive. The great capricorn beetle usually lives in deadwood of standing veteran oak trees (Quercus sp) and other deciduous species such as chestnuts, birch, willow, ash, elm, walnut, hazel, carob, beech, hornbeam etc…In parts of its range, the range of possible host trees is much more restricted, i.e. to white oaks (Quercus robur and Q. petraea).The species usually completes its life cycle in 3-5 years. The eggs are laid in deadwood part of living, very old and unshaded trees (usually injuries on the trunk or in branches of very old trees). The larvae stay under the bark in the first year, and in the second year they go deeper into the wood, on which they feed. Adults are generally active at twilight and feed on the sap that appears on injuries in the bark and on mature fruit. https://www.iucnredlist.org/species/4166/10503380
Lucanus cervus	This species is listed on Annex II of the EU Habitats Directive and Appendix III of the Bern Convention. This is an obligate saproxylic species. The larvae develop in moist decaying wood near or below the soil surface, including decaying old stumps, but also in the base of fence posts; always decay from white-rot fungi; and generally in light soils. Adults feed on fruit and sap, and fly mainly in the evening. In Ukraine larvae mostly live in wood of oak (Quercus), sometimes other broad-leaved trees. In European Turkey larvae develop in dead wood of Castanea, Fraxinus, Populus, Quercus, Salix, Tilia. The species needs big trunks and stumps. https://www.iucnredlist.org/species/157554/5094499
Ampedus cardinalis	It is on the IUCN Red List. This is an obligate saproxylic species. A heartwood decay specialist, typically found in very large old trees. The larvae develop in red-rotten heartwood of living old oaks Quercus, in smaller boughs as well as trunks. There is a long larval period and adult dormancy; the adults remaining in their pupal cells from September until the following April, and they may normally

	be found under loose bark or in hollows from May to July. The larvae are predators or necrophagous. In Italy it is found in coniferous as well as broad-leaved trees. In Hungary virtually all known records are from red-rotten wood of very old oaks. In France larvae are found in the dry powder of red-rot in large trees of Quercus or Castanea.In the Czech Republic and Slovakia it lives in trunks of solitary old oaks in broad-leaf or mixed forests. https://www.iucnredlist.org/species/157800/5149054

Cavity-using birds

Veteran trees provide birds with more essential resources than other trees. These include food sources, in the form of invertebrates associated with decaying wood or bark, together with tree cavities, which can serve as nest sites for a wide range of birds. Some birds – such as owls, kestrels, marsh tit and tree-creeper – adopt existing cavities with little or no modification, while others – including woodpeckers and nuthatch – modify the cavity and its access considerably. Modification of cavities can influence the range of invertebrates living in them. Some birds, mainly woodpeckers, break into decaying wood in search of food but most others – even nuthatch and tree-creeper – usually glean their prey from external surfaces and shallow cavities.

Species	Habitat requirements
Green woodpecker (Picus viridis)	This species uses a great variety of semi-open habitats. It is confined to larger open sections or clearings in extensively wooded areas, forest edges, copses, parks, orchards and residential areas, usually near mature deciduous trees. The nest is excavated in dead or soft, living wood in unbroken trees and it often nests in the same trees over many years. It feeds predominantly on ants, generally preferring larger ant species. Other insects are also taken, as are earthworms and snails and occasionally reptiles, fruits, berries and seeds. The species is resident, although some local winter movements occur.
Pied flycatcher (Ficedula hypoleuca)	This species breeds in most well-wooded and forest habitats, so long as suitable cavities for nest-sites are present. It prefers deciduous forests (which contain more natural cavities) over coniferous forest. In Europe, its typical habitat is deciduous and mixed, sunny, open mature woodland, supplemented by orchards, avenues, parks, and even gardens in low-density human settlements. Breeding occurs from late April to the end of June in Europe. The nest is a loose cup of dead leaves, plant stems and moss, which is lined with rootlets, fine grasses, hair and (sometimes) feathers. It is sited 1.8-10 m above the ground in a hole in a tree, sometimes a wall or building. The diet is mostly insects, both flying and non-flying, but it will take other invertebrates and some fruit and seeds. The species

	is migratory, with all races believed to winter in west Africa.
Common starling (Sturnus vulgaris)	During the breeding season this species occupies open countryside, with access to suitable nesting and roosting sites. It requires cavity nest-sites, typically in woodland or on man-made structures, close to open areas of short grassland for foraging. At other times it exploits a wide range of habitats, including moorland, saltmarshes, seashore and tidal flats, stubble fields, orchards, refuse dumps and sewage-treatment works. Breeding occurs mostly between March and July. The nest is a bulky structure of dry grass, conifer needles, twigs, string and other materials and the cup is lined with softer materials such as grass, feathers, moss, wool, hair and paper, fresh green leaves and flowers. It is typically built in a hole in a tree, cliff, building or other structure and nest boxes are also readily used. It is omnivorous, taking animal and plant material all year round but during the spring animal food predominates and is fed almost exclusively to nestlings. The northern and eastern populations are migratory whereas southern and western populations as well as those in urban areas tend to be resident.
Tawny owl (Strix aluco)	The primary habitat of this species is broad-leaved forest, however it adapts well to man-made and altered habitats. The breeding season is from February to July. It nests in holes in trees, cliffs, buildings and steep river banks. Also often uses nest boxes, the old nests of large birds, burrows of large mammals, dreys of squirrels (Sciurus) and shallow depressions on the ground at the base of a tree or beneath a bush. Typically it lays three to five eggs. It feeds on small mammals and small birds and will also consume amphibians, reptiles, earthworms, snails, beetles and other insects and occasionally fish. The species is sedentary and highly territorial.
Nuthatch (*Sitta europaea*)	This species inhabits mature forest with large old trees and a well-developed canopy providing extensive foraging areas, as well as nesting cavities. In much of Europe it prefers deciduous and mixed forest, especially oak (Quercus), but is also found in riverine woodland, parkland, old orchards, cemeteries, and sometimes large gardens. Egg-laying occurs mainly from late-April to May but varies with latitude and altitude. The nest is a foundation of wood chips surmounted by bark flakes and rarely incorporating dry leaves, lichen, conifer -needles and the like. It is sited in the hole in a tree, which is either natural or, more often an abandoned woodpecker hole. It feeds on insects but in the autumn and winter it takes seeds, nuts and sometimes flower buds and sap. The species is generally sedentary, but juveniles may disperse over short distances in late summer and autumn; occasionally these movements become irruptive.

Cavity-using mammals

Tree cavities provide very important roost sites for bats and a high proportion of bats are dependent on them. Bechstein's is believed mainly to use rot-holes in the larger boughs high in the canopy, whereas barbastelle appears to be more characteristic of the cavities behind loose bark on ancient and veteran trees. The impacts of the accumulation of bat droppings and urine within the tree have not been studied. Bat guano makes good garden compost so presumably the tree is able to benefit from its degradation within its cavities. The guano probably supports an interesting invertebrate fauna, but this too has not been studied.

Mammals other than bats also use tree cavities, particularly squirrels, but also foxes, pine marten and anything else seeking dry sheltered conditions for resting, sleeping or even hibernation.

Species	Habitat requirements
Westerna barbastelle bat (Barbastella barbastellus)	This species forages in mature woodland and woodland edges, feeding mostly on large moths. In summer, roosting sites occur in mature woodlands and occasionally in older buildings. This bat shows a high fidelity to roosting and foraging areas but not to single trees, which are changed frequently. In winter the hibernation may start in trees, but later underground sites are preferred. Recent data suggest that hibernacula are visited in the pre-hibernation period and used also as breeding sites.
Bechsteins bat (Myotis bechsteinii)	This species has specialised habitat requirements, and is largely dependent on mature natural forests.In Europe, it tends to prefer mature deciduous woodland of beech and oak with a high proportion of old trees. Densities of this species are highest in forests that are managed according to environmental (rather than strictly economic) principles. It is occasionally found in habitats such as pasture, orchards and rural gardens. In summer it roosts in tree-holes, or occasionally in buildings; bird and bat boxes are fairly readily accepted. In winter it hibernates in underground habitats, and possibly also in hollow trees. It forages in woodland and along woodland edge for Lepidoptera, Diptera, Planipennia, and also non-flying insects.
Pine Marten (Martes martes)	Pine martens are generalist predators, feeding on small rodents, birds, beetles, carrion, eggs and fungi. In autumn, berries are a staple. Marten dens are commonly found in hollow trees or the fallen root masses of Scots pines. Cairns and cliffs covered with scrub can be used as alternative den sites. Martens have territories that vary in size according to habitat and food availability. For males, these are about 10-25 square kilometres and for females about 5-15 square kilometres. They mark their territories with faeces (known as scats) deposited in places where they are conspicuous to other martens; they are frequently left along forestry trails.

Common noctule (Nyctalus noctula)	This species is often associated with old trees and associated with a varied rural landscape. Nursery colonies, which can contain up to 50 females, often establish in hollow trees or old woodpecker holes. The nursery colony moves regularly, probably to avoid predation. They overwinter in trees and buildings.
Red squirrel (*Sciurus vulgaris)*	The red squirrel is an arboreal creature and moves deftly through the trees. It has a varied distribution across Europe due to competition with the American Grey Squirrel. It eats nuts and cones, berries, mushrooms and sometimes even acorns. They build their nests in trees with twigs and lichens, but they sometimes use tree cavities and can have up to eight young.