Catalogue of tree microhabitats

Reference field list

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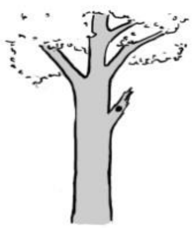
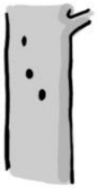
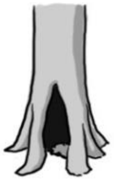
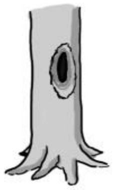
Large quantities of deadwood and a high density of old microhabitat-bearing trees are characteristic elements of natural forests, especially of the old-growth phases. These are often absent or rare in managed forests, even in forests under close-to-nature management. Yet, an important share of forest biodiversity is strictly or primarily dependent on such elements for their survival, especially 'saproxylic' species, those are species depending on deadwood.

Tree related microhabitats are therefore recognised as important substrates and structures for biodiversity in forests. The retention of both existing and future tree microhabitats is thus one important aspect to take in to consideration in forest management. Giving tree microhabitats increased attention will help sustain and increase the habitat value for biodiversity also in managed forests .

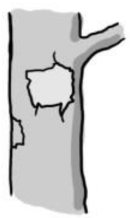
This reference field list is developed to support training exercises conducted in Integrate+ Marteloscope sites. It aims at supporting forest managers, inventory personnel and other groups in identifying and describing tree microhabitats in the course of such exercises. It can also find use as illustrative material in forest education and as background documentation for other training events and field excursions.

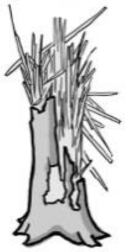
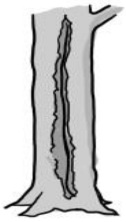
CV1

Illustrations	Code	Type	Description	Saproxylic microhabitats
	Woodpecker cavities			Cavities
	CV11	ø = 4 cm	Cavity entrance about ø = 4 cm with a larger interior diameter of the cavity. The cavity of *Dendrocopos minor* is built in crown branches.	
 	CV12	ø = 5 - 6 cm	Cavity entrance about ø = 5 - 6 cm with a larger interior diameter of the cavity. *Picus viridis* builds its cavity into the trunk into the insertion of broken-off branches. The entrance is round in accordance with the round form of the branch insertion. The cavities of the medium-sized woodpeckers such as *Dendrocopos major* are built into decaying branch insertions, dead branches or snags.	
	CV13	ø > 10 cm	Woodpecker hole in the trunk that indicates a cavity of *Dryocopus martius.* The cavity entrance width is about ø > 10 cm with a larger interior diameter. Black woodpeckers build cavities with an oval entrance at trunk free of branches. The cavity trees have mostly a minimum average of 40 cm dbh thus it can remain for a longer decaying time (2 - 3 decades).	
	CV14	ø ≥ 10 cm (feeding hole)	The excavation is conical: the entrance is larger than the interior.	

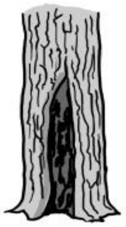
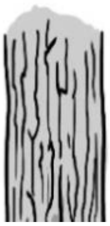
Saproxylic microhabitats	Description	Type	Code	Illustrations
Cavities	At least three in the trunk connected woodpecker breeding cavities. If this cannot be checked: three cavity openings within two meters.	Woodpecker "flute“ / cavity string	CV15	
		Trunk and mould cavities		
	Trunk cavity with mould, cavity bottom has ground contact thus soil humidity enters the cavity hole. Note that the cavity entrance can be higher at the trunk.	ø ≥ 10 cm (ground contact)	CV21	
		ø ≥ 30 cm (ground contact)	CV22	
	Mould containing trunk cavity without ground contact.	ø ≥ 10 cm	CV23	 
		ø ≥ 30 cm	CV24	
	Semi-open trunk cavity with or without mould, cavity chamber is not completely protected from surrounding microclimate and precipitation may enter the interior. Note that the cavity entrance can be higher at the trunk.	ø ≥ 30 cm / semi-open	CV25	
	Large trunk cavity with open top and with or without ground contact.	ø ≥ 30 cm / open top	CV26	

Illustrations	Code	Type	Description	Saproxylic microhabitats
CV3	**Branch holes**			Cavities
	CV31	ø ≥ 5 cm	Rot-holes originating from branch breakage at trunk when fungal decay of wood is progressing faster than occlusion of wound.	
	CV32	ø ≥ 10 cm		
	CV33	Hollow branch, ø ≥ 10 cm	Hollow more or less horizontal branch developing from breakage. Provides tubular shelter from surrounding microclimate.	
CV4	**Dendrotelms and water-filled holes**			
	CV41	ø ≥ 3 cm / trunk base	The entrance diameter is the same as the chamber´s interior. Cup-shaped concavities that, due to their form, retain precipitation for a certain period of time (until it dries out).	
	CV42	ø ≥ 15 cm / trunk base		
	CV43	ø ≥ 5cm / crown	The entrance diameter is the same as the chamber´s interior. Cup-shaped concavities that, due to their form, retain precipitation for a certain period of time (until it dries out).	
	CV44	ø ≥ 15 cm / crown		

Saproxylic microhabitats	Description	Type	Code	Illustrations
Cavities	**Insect galleries and bore holes**			
	The entrance or exit diameter is the same as the interior's hole diameter. A bore hole net of xylophagous insects indicates a wood hole system. An insect gallery is a complex system of holes and chambers created by one or more insect species within the trunk.	Gallery with single small bore holes	CV51	 CV5
		Large bore hole ø ≥ 2 cm	CV52	
Injuries and wounds	**Bark loss / exposed sapwood**			
	Loss of trunk bark thus sapwood is exposed; caused e.g. by felling, natural falling of trees, rock fall. At the trunk base, bark loss may also be caused by skidding of logs, rodents, woodpecker sloughing.	Bark loss 25 - 600 cm^2, decay stage < 3	IN11	 IN1
		Bark loss > 600 cm^2, decay stage < 3	IN12	
		Bark loss 25 - 600 cm^2, Decay stage = 3	IN13	
		Bark loss > 600 cm^2, decay stage = 3	IN14	
	Exposed heartwood / trunk and crown breakage			
	The tree has broken off at the trunk level, in a living tree. The tree is still alive and is developing a secondary crown with parts of the trunk decaying near the injury: the tree combines large decaying wood with xylem and phloem flux.	Broken trunk, ø ≥ 20 cm at the broken end	IN21	 IN2

Illustrations	Code	Type	Description	Saproxylic microhabitats
 	IN22	Broken tree crown / fork Exposed wood ≥ 300 cm^2	Exposed heartwood through the fork insertion breakage into the trunk - the rot initiates decaying substrate on the living tree.	Injuries and wounds
 	IN23	Broken limb, ø ≥ 20 cm at the broken end	A 1st order branch has broken off. The tree is still alive. The injury provides a large entry gate for organisms and may develop into a cavity (rot hole) with xylem and phloem flux.	
	IN24	Splintered stem, ø ≥ 20 cm at the broken end	At wind breakage, trunk has splintered with several long splinters due to high force: splintered wound provides specific ecological conditions.	
	Cracks and scars			
	IN31 IN32	Length ≥ 30 cm; width > 1 cm; depth > 10 cm Length ≥ 100 cm; width > 1 cm; depth > 10 cm	Line-shaped injury (cleft) through the bark into the sapwood, exposing cambium and sapwood (not to be recorded if injury has occluded).	

IN3

Saproxylic microhabitats	Description	Type	Code	Illustrations
Injuries and wounds	Bark loss and crack caused by lightning strike exposing the sapwood (not recorded when new bark has closed the scar).	Lightning scar	IN33	
	Fire scars at the lower trunk usually have a triangular shape and are located at the base of the tree on the leeward trunk side. Fire scars are associated with charred wood and eventually resin flow on exposed sapwood or bark.	Fire scar, ≥ 600 cm²	IN34	
Bark			**Bark pockets**	
	Space between bark and sapwood forming a shelter (open at the bottom).	Bark shelter, width > 1 cm; depth > 10 cm; height > 10 cm	BA11	
	Space between bark and sapwood forming a pocket (open at the top), eventually containing mould.	Bark pocket, width > 1 cm; depth > 10 cm; height > 10 cm	BA12	
			Bark structure	
	Coarse and fissured bark, sometimes tree species specific.	Coarse bark	BA21	

BA1

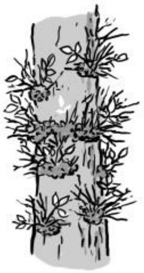
BA2

DE1

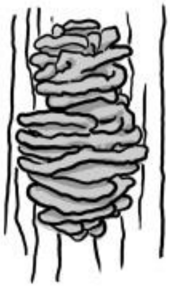
Illustrations	Code	Type	Description	Saproxylic microhabitats
	Dead branches and limbs / crown deadwood			Deadwood
	DE11	ø 10 - 20 cm, ≥ 50 cm, sun exposed	Smaller sized (> 10 cm diameter) decaying wood, often horizontal or at a skewed angle, often in the shadow of the remaining canopy; in contact with living wood (xylem and phloem flow).	
	DE12	ø > 20 cm, ≥ 50 cm, sun exposed		
	DE13	ø 10 - 20 cm, ≥ 50 cm, not sun exposed		
	DE14	ø > 20 cm, ≥ 50 cm, not sun exposed		
	DE15	Dead top ø ≥ 10 cm		

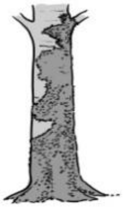
GR1

Illustrations	Code	Type	Description	Epixylic microhabitats
	Root buttress cavities			Deformation / growth form
	GR11	ø ≥ 5 cm	Natural cavity at the base of the tree trunk formed by the tree roots. May be densely covered with bryophytes. No wound or rot-hole.	
	GR12	ø ≥ 10 cm		
	GR13	Trunk cleavage, length ≥ 30 cm	Cleft formed by tree growth, no wound or open crack. Enclosure located higher at the trunk and therefore not part of the root buttress.	

Epixylic microhabitats	Description	Type	Code	Illustrations
Deformation / growth form		**Witches broom**		GR2
	Dense agglomeration of twigs caused by a parasite (such as the fungi *Melampsorella caryophylacerum* or *Taphrina betulina*) or hemiparasite (genus *Arceuthobium*, *Viscaceae*).	Witches broom, ø > 50 cm	GR21	
	Dense agglomeration of shoots on the trunk or branches of a tree. They originate from latent buds visible on the tree or can be submerged under the bark as epicormic buds.	Water sprout	GR22	
		Cankers and burrs		GR3
	Proliferation of cell growth with rough bark and bark damage at the canker surface.	Cancerous growth, ø > 20 cm	GR31	
	Decayed canker exposing necrotic tissue, e.g. caused by *Nectria* spp. on beech.	Decayed canker, ø > 20 cm	GR32	

EP1

Illustrations	Code	Type	Description	Epixylic microhabitats
	Fruiting bodies fungi			
	EP11	Annual polypores, ø > 5cm	Fruiting bodies of polypores at the tree trunk lasting some weeks. European polypores only have one layer of tubes and are mostly of tough elastic soft consistency (no woody parts). Many species do not develop fruiting bodies each year. Main annual genera are *Abortiporus, Amylocystis, Bjerkandera, Bondarzewia, Cerrena, Climacocystis, Fistulina, Gloeophyllum, Grifola, Hapalopilus, Inonotus, Ischnoderma, Laetiporus, Leptoporus, Meripilus, Oligoporus, Oxyporus, Perenniporia, Phaeolus, Piptoporus, Podofomes, Polyporus, Pycnoporus, Spongipellis, Stereum, Trametes, Trichaptum, Tyromyces* (underlined genera known to host a wide diversity / rare invertebrates).	Epiphytes
	EP12	Perennial polypores, ø > 10 cm	Woody, or at least tough fruiting bodies, showing distinct annual layers in the tube layer. Perennial fruiting bodies of the fungi indicating trunk decay caused by white rot (e.g. *Fomes fomentarius* (L. ex Fr.) Fr.) and brown rot (e.g. *Fomitopsis pinicola* (Swartz ex Fr.) Karst.). Main perennial genera are *Fomitopsis, Fomes, Perreniporia, Oxyporus, Ganoderma, Phellinus, Daedalea, Haploporus, Heterobasidion, Hexagonia, Laricifomes, Daedleopsis* (underlined genera known to host a wide diversity / rare invertebrates).	
	EP13	Pulpy agaric, ø > 5 cm	Large, thick and pulpy or rather fleshy fruiting body of gill-bearing fungus (order Agaricales) - an agaric is a type of fungal fruiting body characterized by the presence of a pileus (cap) that is clearly differentiated from the stipe (stalk), with lamellae (gills) on the under-side of the pileus. "Agaric" can also refer to a basidiomycete species characterized by an agaric-type fruiting body. Examples: *Armillaria, Pleurotus, Megacollybia*, large *Pluteus* bear many arthropods and also parasitic fungi. The fruiting body remains generally several weeks.	

Epixylic microhabitats	Description	Type	Code	Illustrations
	Fungi cover of large tough hemispheric dark fungus looking like a lump of coal. Genus examples are *Daldinia* and *Hypoxylon.*	Large ascomycetes, ø > 5 cm	EP14	
		Myxomycetes		
	Amoeboid slime mould which forms moving plasmodium looking like gelatinous mass when fresh.	Myxomycetes, ø > 5 cm	EP21	
		Epiphytic crypto- and phanerogams		
Epiphytes	Tree trunk covered by mosses and liverworts.	Epiphytic bryophytes coverage > 25 %	EP31	
	Tree trunk covered by foliose and fruticose lichens (often in association with bryophytes).	Epiphytic foliose and fruticose lichens, coverage > 25 %	EP32	
	Lianas and other climbing plants cover the trunk surface (e.g. *Hedera helix*, *Clematis vitalba*).	Lianas, coverage > 25 %	EP33	

EP2

EP3

Illustrations	Code	Type	Description	Epixylic microhabitats
	EP34	Epiphytic ferns, > 5 fronds	Epiphytic ferns on trunk and large branches, often associated with bryophytes.	Epiphytes
	EP35	Mistletoe	Occurrence of these epiphytic and hemiparasitic plant species in the tree crown (*Viscum* spp., *Arceuthobium* spp., *Amyena* spp., *Loranthus* spp.).	

NE1

	Nests			Nests
	NE11	Large vertebrate nest, ø > 80 cm	Structures built by big raptors (eagles, black or white stork, grey heron) to hold eggs, offspring, or occasionally the animal itself. They may be composed of organic material such as twigs, grass, and leaves, and are located on branches, forks or witch brooms.	
	NE12	Small vertebrate nest, ø > 10 cm	Nests built by small bird species, dormouse, mouse or squirrel.	
	NE21	Invertebrate nest	Larval nest of the pine processionary moth (*Thaumetopoea pityocampa),* nest of the wood ant (*Lasius fuliginosus)* and of feral bees in tree trunk.	

OT1

	Sap and resin run			Other
	OT11	Sap flow, > 50 cm	Fresh significant flow of sap, mainly at deciduous tree species.	

Epixylic microhabitats	Description	Type	Code	Illustrations
Other	Fresh significant flow of resin, at coniferous tree species.	Resin flow and pockets, > 50 cm	OT12	
			Microsoil	
	Result of micro-pedogenesis from epiphytic mosses, lichens or algae and necrosed old bark.	Crown microsoil	OT21	
		Bark microsoil	OT22	

OT2

Integrate+ is a demonstration project funded by the German Federal Ministry of Food and Agriculture (BMEL) to establish a European network of demonstration sites for the integration of biodiversity conservation into forest management.

The Integrate+ project runs from December 2013 to December 2016 and builds on a partner network from research and practice with a focus on implementation of integrative management and enhancing transnational exchange of experiences.

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