Manual
on Wood-destroying Insects and their Monitoring

by

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Contents

1. Before inspection

1.1 Equipment

01 Measuring device (meter, cm-cards, etc.)
02 Compass/ magnifying device / thermometer
03 Glass and/or plastic containers
04 (Swiss) knife
05 Video light
06 Magnifying glass/device, hand lens
07 Torch
08 Wood moisture meter
09 Identification guide/book
10 Pencil, ballpoint-pen, marker, etc.
11 Sticky points (colored!!!)
12 Exhaustor (for crawling insects)
13 Camera (plus flash)
14 Chisel
15 Axe
16 Plastic bags
17 College block, notebook, etc.

Not shown:
Extra batteries
Charger
Tweezers
Pincer
Hammer
Pins
Paint brush (small)

Notebook
Laptop/netbook

Monitoring paper, traps, etc. (see Annex 10)

Boroscope
Other equipment, meters, sensors

1.2 Prior information on respective object

- History of building (e.g., use of building)
- Plan drawings, sketches, photographs, other documents
- Interview with owner, persons in charge, etc.
- Renovations and restaurations? When renoveted or restaured?
- Introduced / build-in wooden parts and objects and time of introduction?
- Use of wood preservatives and date of application? Which ones (specify)? Application?
- Other control measures applied? When applied?
- Extensive building damages (especially leakages) in former times?
- Heating regime? Entire building or parts heated sporadically or regularly?
- Ventilation regime? Windows, doors, etc. opened sporadically or regularly?

2. Assessment of an object

2.1 General classification of building

- Cathedral, church, chapel
- Ensemble/farmstead (main building, barn, stable, sauna, etc.; specify also usage)
- (Dwelling) house (with cellar, 1st to nth floor, attic; rooms to be specified)
- (Wind) mill (floors to be specified)
- Other building (specify)

Outside/exterior

- Location (in town/village, in/near forest, near lake/river/etc.; specify)
- Damages by organisms (fungi, insects, algae, bacteria, etc.; specify)
- Material/constructional damages (obvious damages at glance; specify)
- Trees and other plants in direct vicinity (specify)
- Sources of humidity/moisture/rain, etc.

Inside/interior (e.g., for a church)

- Wooden construction (Wing assembly, roof construction, flooring, panelling, beams, rafters, etc.)
- Wooden objects
  - Stationary: Altar(s), pulpit, benches, organ, confession booth, gallery, stairs, tower, roof(s), others (specify)
  - Movable: Picture frames, tables, cupboards, others (specify)
- Other damages (wall cracks, moisture, discoloration, dampness, corrosion, etc.; specify)

2.2 General and detailed questions to be considered specifically referring to damages caused by insects

2.2.1 Are there **wooden objects** and/or **wooden constructions** in the building?

- What **kind of wooden parts** are there? (objects, artefacts, constructions, floor boards, others)
- Are the wooden parts **covered my surface layers** (paints, varnish, plastic, etc.)?
- Are there other **materials covering** the wood/timber? (cloths, leather, cardboard, etc.)
- Are the wooden parts **covered by bark** or parts of bark?
- Are the wooden parts **treated with wood preservatives**? (colour, smell, written notices, word of mouth, etc.)
- Which **wood species** are the parts made of? (resinous/softwoods, hardwoods, wood species)

2.2.2 Are there any **damages** visible in or on the wooden parts? (caused by insects, fungi, moulds; or of mechanical or chemical origin)

2.2.3 Are there **signs of insect attack** in the wooden parts?

a) Is there **bore dust** (= gnawing particles + fecal pellets/frass) in the vicinity of the wooden parts? (see pp. 6 - 9)

- Are there **distinctly shaped particles** in the bore dust? (use naked eye, magnifying glass)
- What is the **shape** of the particles? (cylindrical, round, spindle-like, irregular, fibrous, divers)
- What is the **color** of the bore dust? (unique, different, specific color)
- What is the **consistency** of the bore dust? (powdery, crumbly, dough-like, solid, fine, coarse, other)
- Is the bore dust accumulated in distinct **heaps**? (flat, tipped, with traces, other)
- Is the bore dust accumulated in **trickling traces** on vertical surfaces?

b) Are there (**emergence**) **holes** in the surfaces of the wooden objects? (see pp. 9 - 13)

- What is the **shape** of these holes? (ovoid, circular, irregular, divers)
- What is the **size** of these holes? (mm, cm)
- What is the **color** of the holes? (light-/dark-colored, different from original wood)
- Are the holes closed or filled with some **other material**? (hint to secondary insects)

c) Are there holes or tunnels obviously only in the **surface layers**?

- Are there **holes** which are only **superficial** and end blindly?
- Are there **tunnels** which run only **superficially**?

d) Are parts of the wood broken off?

- Are **bore tunnels** visible? (see pp. 9 – 11, 13)
  - What is the **shape** of the tunnel cross-section? (ovoid, circular, cavity-like)
  - What **color** are the tunnel surfaces? (light-, dark-colored)
  - Are there distinct **patterns of tunnels**? (distinct shapes, only in early wood, cavities)
  - Are the tunnels **empty**? (totally, in part, only near surface)
  - Are the tunnels **filled** with bore dust? (stuffed, loose)
  - Are they filled with other materials (dead insects, leaf material, organic accumulations)
- Are there **massive damages** visible? (see pp. 9, 11, 13)
  - Are there damages with **lamellar structures** and larger cavities?
  - Are these damages **irregularly structured**?
- Are parts **cracked or broken** in part or completely?
- Are the wooden **surfaces warped/corrugated** or irregularly folded?
- Are there **discolorations** of the natural wood surface?

e) Is there **other material in the vicinity** of the wooden parts? (fruit bodies, spores, biofilms, etc.)

2.2.4 Are there **insects visible** in the vicinity of the wood? (beetles, wasps, ants, moths, termites, other)

- What is the **shape/habitus** of the insect(s)?
- What is the **color** of the insect(s)?
- What is the **size** of the insect(s)?
- Are these insects **all alike** or different from one another?
- Are the insects occurring in large **quantity**?
- Are the insects occurring **everywhere** in the entity?
- Are the insects occurring in **distinct places**?
    - Are insects visible in or near corners, **window sills**, **spider webs**, light sources, etc.?
    - Are there accumulations of **insect parts** somewhere?
- Are there **other arthropods** (i.e., potential predators, secondary insects) visible in the vicinity of the damages? (spiders, other wasps, etc.)

2.2.5 What are the **room conditions**?

- **Temperature** (heating system, heating regime)
- **Relative humidity** (ventilation, etc.)
- **Wood moisture**
- **Building damages** (especially sources of moisture; construction failures; etc.)
- **Storing conditions** (building quality, packed storage, etc.)

3. Assessment of damages by wood-destroying insects

3.1. Bore dust (see pp. 7 - 9)

- Color (light, dark, multi-colored)
- Consistency and texture (loose, lumpy, stuffed)
- Shape of faecal pellets (cylindrical, round, irregular, etc.; missing)
- Shape and size of gnawing particles
- Accumulations (heaps, powder, trickling, spider webs)

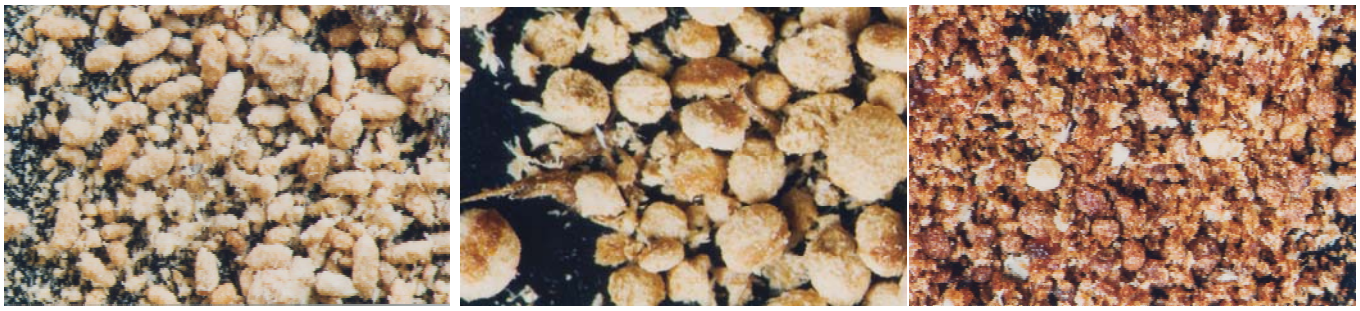
Colors may differ from the original wood color to all discolorations due to ageing, chemical modification and physical decomposition. Depending on the material fed on or gnawed on there may be diverse colors within the collected bore dust (e.g. particles of bark, sapwood or light or dark original timber). Specifically shaped fecal pellets may decompose to finer material when drying, even powder (talc-like) may result (anobiid, cerambycid beetles). Gnawing particles of ants may consist of timber, insulation materials, etc. Distinct shapes of fecal pellets may last for decades (XR, drywood termites) and be embedded in otherwise stuffed and packed material due to moistening as for example in old HB infestations.
Not all brown colored bore dust recognized at first sight is really true bore dust when looked at closer: brown sand expelled by ants or spores of some wood-destroying fungus may be registered.
Different colors of bore dust can be found in even one structural eolement (e.g. floor board) depending on previous decompostion by organisms, chemical or physical reasons.
Furthermore, large heaps of bore dust are in case of different anobiid species often expelled by their antagonists namely the larvae of clerid beetles (Cleridae).
One may find the heaps destroyed by traces resulting from emerging clerid larvae or other insects or spiders wandering around.
Quite often these heaps of bore dust are distinctly tipped, resulting from trickling bore dust from one specific emergence hole.
Not rarely bore dust may clearly indicate the activity of wood-boring Insects (anobiids) and their antagonists (clerid species) when studying spider webs. These webs serve as a helpful indicator for collecting and identifying the wood-boring insects. Since spider webs are very often found near and at window frames and window sills they need specific attention.

Bore dust

Bore dust generally consists of gnawing particles (minute gnawed wooden parts) and fecal pellets (= frass) mostly of characteristic shape. (Relative magnification in following figures for comparison, e.g. [40x])

Bore dust of selected species

House longhorn beetle (*Hylotrupes bajulus* (L.); [40x]); Blue tanbark beetle (*Callidium violaceum* (L.); [40]); Oak longhorn beetle or tanbark borer (*Phymatodes testaceus* (L.); [50x])



Common furniture beetle (*Anobium punctatum* (De Geer); [50x]); Deathwatch beetle (*Xestobium rufovillosum* (De Geer); [40x]); Pine bark anobiid (*Ernobius mollis* (L.); 30x])

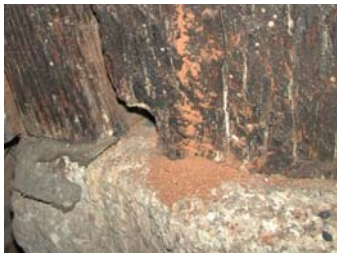
Timberworm (*Hylecoetus dermestoides* (L.); [40x]); Greater horntail wasp (*Urocerus gigas* (L.); [7.5x]); Brown lyctid beetle (*Lyctus brunneus* (Stephens); [40x])

Wood weevil (*Rhyncolus punctatulus* Boh.; [50x]); Drywood termite (*Cryptotermes brevis* (Walker); [50x]); Bostrichid species (*Apate monachus* Fabricius; [40x])

Finding and assessing bore dust (Monitoring)



Heaps of bore dust which trickled from different parts and accumulated below (*Xestobium*, *Anobium*)


Heaps of bore dust expelled by antagonists, by knocking at the construction, and by mice walking around (all *Xestobium* bore dust)

Brown sand expelled by ants

Accumulation of brown spores of fungi


Anobium bore dust with different colors expelled from similar or same floor boards by clerid antagonists




Light colored *Anobium* bore dust expelled by antagonists with beetle and tracks of antagonistic clerid larvae



Light colored *Anobium* bore dust expelled by clerid antagonists in tipped heaps

Role of spider webs for detection of *Anobium* bore dust

Role of windows and window sills for detection of wood-destroying insects and their antagonists

3.2 Openings in wood

3.2.1 **Emergence holes** (see pp. 11, 12)

- Shape (circular, ovoid, irregular; sharp edged, fringed, with other material added)
- Size ("ranges": 1mm, 2-4mm, 5-8mm, 9-30mm, >30mm)
- Color (light ≈ "fresh", dark ≈ "old"; "painted" ≈ with some layer of paint)
- Distribution (sapwood / heartwood; orientation and specific region of wooden construction part; original / restored timber; construction / object)
- Quantity, density; concentrated, randomly dispersed, specific orientation to light, heat, etc.)

3.2.2 **Tunnels, cavities, other openings** (see p. 13)

- Shape (circular, ovoid, irregular)
- Size ("ranges": 1mm, 2-4mm, 5-8mm, 9-30mm, >30mm)
- Openings and cavities regular (following annual rings; only sap-/heartwood; other forms; with other material added)

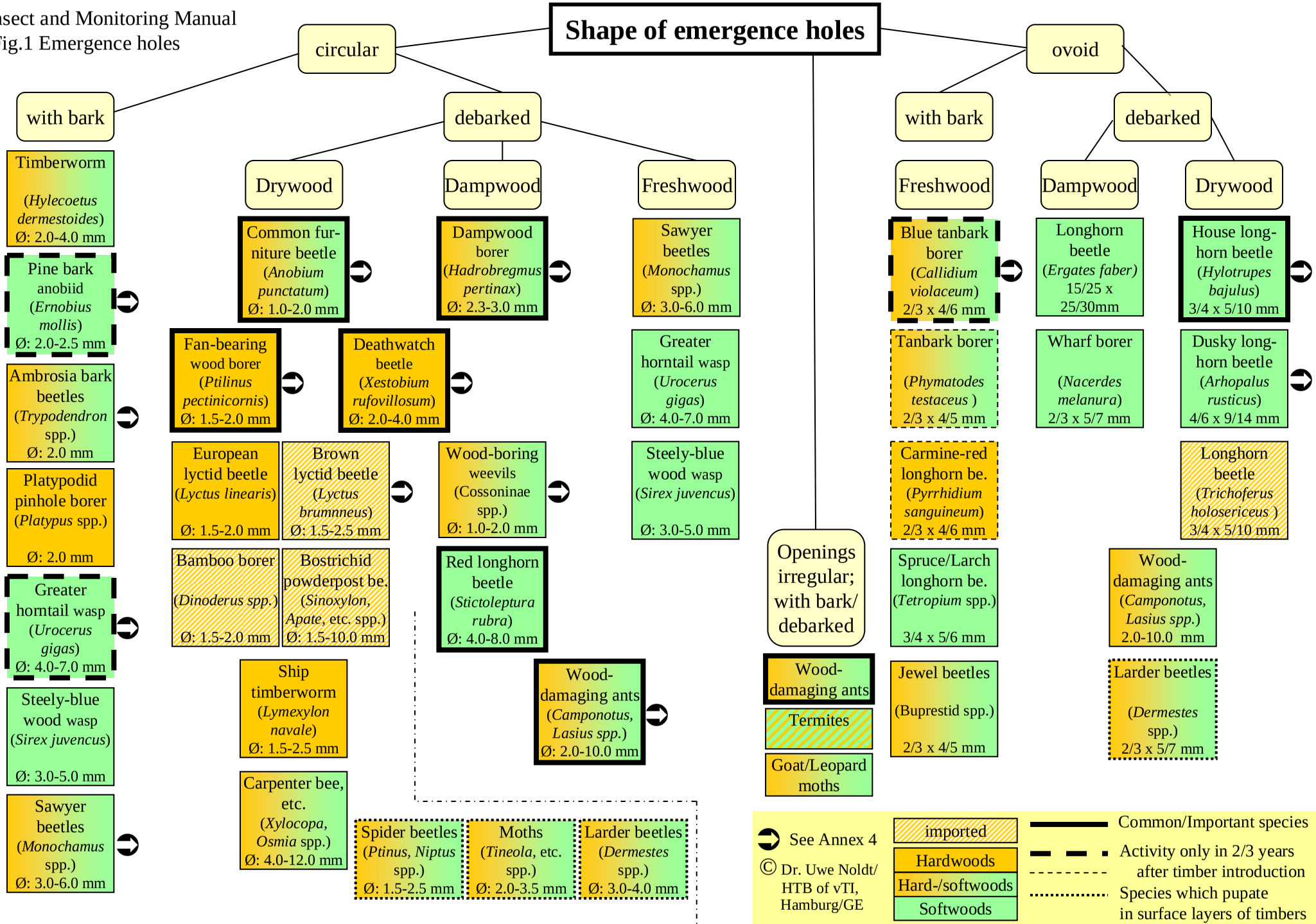
Shapes and sizes of openings are diverse, but may still be very characteristic for a species or a taxon when taking into account always the other parameters and factors of biological, chemical, and physical status of the respective wood or timber. These openings can be emergence holes, entrance holes, sectioned tunnels, broken-off damages or minute in size the holes of ovipositors. Take into account that there can be other artificial openings like holes from pins, nails, darts, bullets, etc. There are no rectangular holes made by any stage of wood-destroying insect.

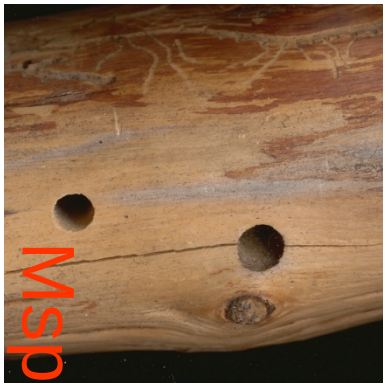
Table 1: Shapes and sizes of openings in wood (cf. Fig. 1, p. 11; Abbreviations XX: abbreviated scientific names, see below)

circular	
Less than 1 mm	- emergence holes (and sectioned tunnels) of lyctid beetles - entrance holes of timberworms (HD, LN) - siricid ovipositor holes - ovipositor holes of hymenopteran antagonists
1 to 2 mm	- emergence holes of hymenopteran antagonists - emergence holes of anobiids (AP, PP), bostrichids (Dsp, etc.), lyctids (LL, LB), cossonine beetles (weevils), scolytids (Tsp), platypodids, ants, termites, sawfly (AG) - entrance holes of ptinid beetles
2 to 4 mm	- emergence holes (and sectioned tunnels) of anobiids (HP, XR, EM), bostrichids, lymexylids (HD, LN), siricid wasps (SJ), cerambycids (Msp), ants, termites - entrance holes of ptinid and larder beetles, moths, ants, termites
4 to 7 mm	emergence holes (and sectioned tunnels) of siricid wasps (UG, SJ), cerambycids (SR, Msp), bostrichids, xylocopid and other beas (Xsp, etc.)
7 to 10 mm	emergence holes (and sectioned tunnels) of bostrichids, xylocopid beas (Xsp)
Larger than 10 mm	emergence holes (and sectioned tunnels) of bostrichids, xylocopid beas (Xsp)
ovoid	
Less than 5 mm (max. length)	- emergence holes cerambycid beetles (PT, CV), buprestids - entrance holes of ants, termites
More than 5 mm (max. length)	- emergence holes cerambycid beetles (CV, PS, Tsp, HB, AR, TH), oedemerids (NM), buprestids - entrance holes of dermestid beetles (Desp), ants
More than 10 mm (max. length)	- emergence holes cerambycid beetles (EF, AR)
irregular	
	- emergence holes ants, termites, goat and leopard moths

Abbreviations in order (from top to bottom): HD – Timberworm (*Hylecoetus dermestoides* (L.)); LN – Ship timberworm (Lymexylon navale (L.); AP – Common furniture beetle (*Anobium punctatum* (De Geer)); PP – Fan-bearing wood borer; Tiny beetle (*Ptilinus pectinicornis* (L.)); Dsp.–.Bamboo borer (*Dinoderus* spp.); LL – European lyctid beetle (*Lyctus linearis* (Goeze)); LB – Brown lyctid beetle (*Lyctus brunneus* (Stephens); Tsp – Ambrosia beetle (*Trypodendron* (=*Xyloterus*) spp.); AG – Dock sawfly (*Ametastegia glabrata* (Fallen); HP – Dampwood borer (*Hadrobregmus pertinax* (L.)); XR – Deathwatch beetle (*Xestobium rufovillosum* (De Geer)); EM – Pine bark anobiid (*Ernobius mollis* (L.)); SJ – Steely-blue wood wasp (*Sirex juvencus* (L.)); Msp – Sawyer beetle (*Monochamus* spp.); UG – Greater horntail wasp (*Urocerus gigas* (L.)); SR – Red longhorn beetle (*Stictoleptura rubra* (L.)); Xsp – Carpenter bee (*Xylocopa* spp.); PT – Tanbark borer (*Phymatodes testaceus* (L.)); CV – Blue tanbark borer (*Callidium violaceum* (L.)); PS – Red tanbark borer (*Pyrrhidium sanguieneum* (L.); Tsp – Longhorn beetles (*Tetropium* spp.); HB – House longhorn beetle (*Hylotrupes bajulus* (L.)); AR – Dusky longhorn beetle (*Arhopalus rusticus* (L.)); TH – Longhorn beetle (*Trichoferus holosericeus* (Rossi)); NM – Wharf borer (*Nacerdes melanura* (L.); Desp – Larder beetles (*Dermestes* spp.); EF – Longhorn beetle (*Ergates faber* (L.)).

Insect and Monitoring Manual
Fig.1 Emergence holes





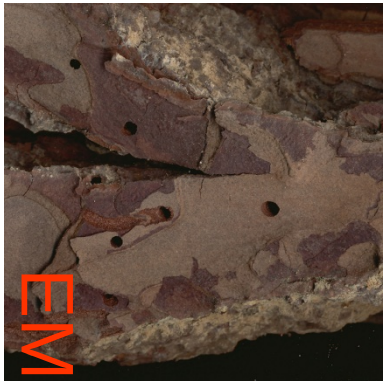
Sawyer beetle species

Red longhorn beetle

Blue tanbark borer

Dusky longhorn beetle

House longhorn beetle

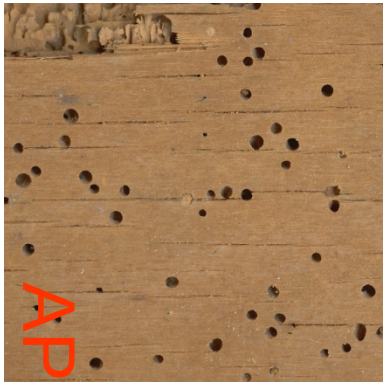


Pine bark anobiid

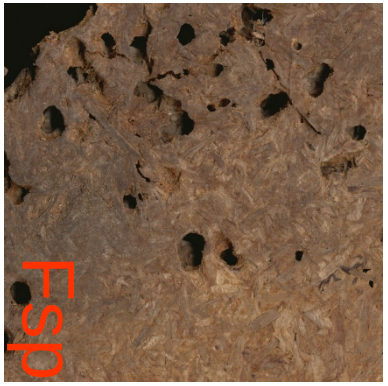
Deathwatch beetle

Dampwood borer

Fan-bearing anobiid beetle



Common furniture beetle

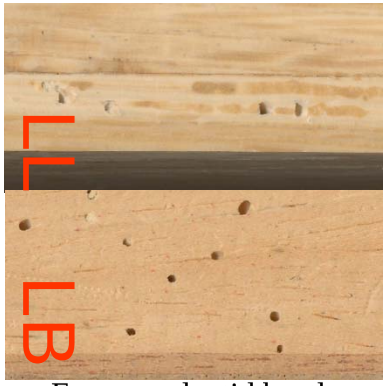


Wood-damaging ant

Wood weevil species

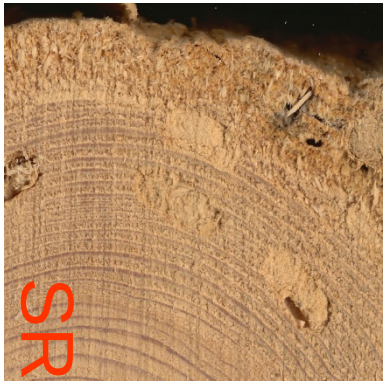
Ambrosia bark beetles

Greater horntail wasp



European lyctid beetle
Brown lyctid beetle

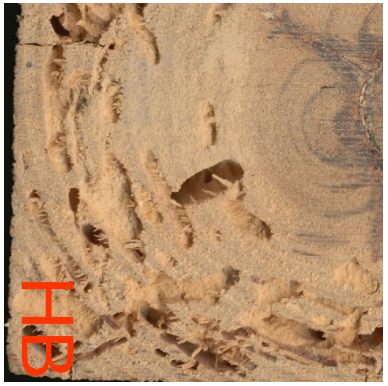
Sawyer beetle species



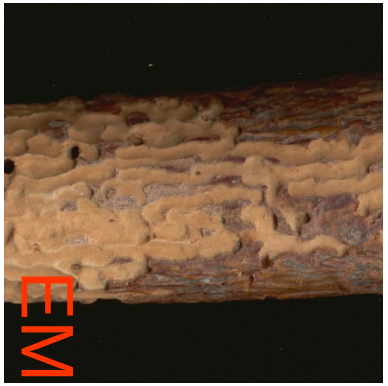
Red longhorn beetle

Blue tanbark borer

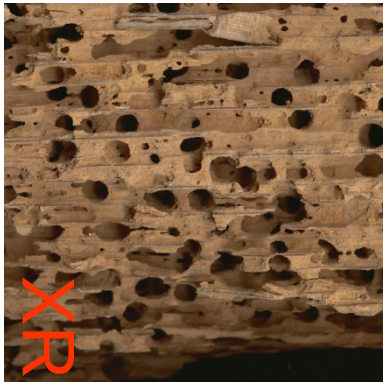
Dusky longhorn beetle



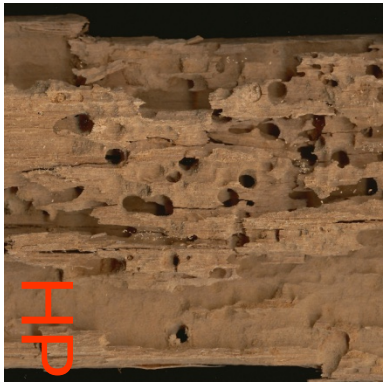
House longhorn beetle



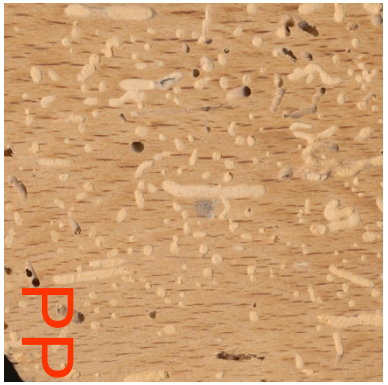
Pine bark anobiid



Deathwatch beetle



Dampwood borer



Fan-bearing anobiid beetle

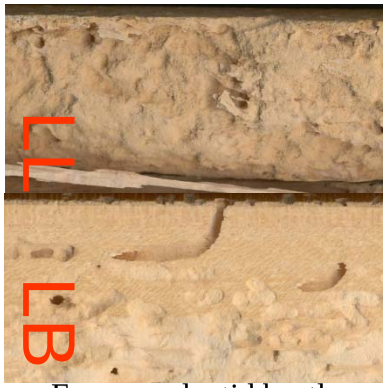
Common furniture beetle

Wood-damaging ant

Wood weevil species

Ambrosia bark beetles

Greater horntail wasp



European lyctid beetle
Brown lyctid beetle

3.3 Insects (general) (see 3.3.1)
Beetles (Coleoptera), wasps, ants (Hymenoptera), moths (Lepidoptera), termites (Isoptera), others (see below)

Insect families including wood-destroying species

Beetles	**Hymenopterans**	**Lepidopterans**	**Termites**
Longhorn beetles	Ants	"Cossid moths"	Subterranean term.
Anobiid beetles	Horntail wasps	Tineid moths	Drywood termites
Lyctid beetles	Bees	Pyralid moths	
Bostrichid beetles	Wasps		
Weevils	Sawflies		
Larder beetles			
Spider beetles			
Bark beetles			
Timberworms			
Pinhole borers			
Wharf borers			

3.3.1 Habitus of Insect Adults

The wood-destroying insects may have a manifold of body shapes, general forms with specific shapes of the 3 body metamers head, thorax, and abdomen, differently shaped body annexes (including extremities, wings, ovipositors, etc.), different colours (not only in the genders), different castes in social insects and many more attributes which do characterize them as specific taxa. Note that in most cases – with exception of members of the two families Bostrichidae and Curculionidae – the adults only destroy the wood by gnawing their emergence holes and that the damages, destruction and deteriorating is caused by the larvae.


Cerambycid beetle
Longhorn beetles


Anobiid beetle
Woodworms


Lyctid beetle
Lyctids


Scolytid beetle
Bark beetles


Siricid wasp
Horntails wasps


Curculionid beetle
Weevils


Dermestid beetle
Larder beetles


Ptinid beetle
Spider beetles


Formicids
Ants


Clerid beetle

3.3.2 Habitus of Insect Larvae

- Shape (cylindrical, ventrally curved, with extra structures; legs visible or missing; adult-like)
- Color (light/dark; ivory-like, yellowish, brownish
- Distinct coloration of specific body parts

Cerambycid beetle
Longhorn beetles

Anobiid beetle
Woodworms

Lyctid beetle
Lyctids

Scolytid beetle
Bark beetles

Siricid wasp
Horntails wasps

Lymexylid beetle
Timberworms

Oedemerid beetle
Wharf borer

3.4. Selected insects, characteristic damages, and antagonists (see pp. 16 - 25)

3.4.1 Selected insect species of economic and destructive importance (Characters of adults, larvae, damages and biology; see pp. 16 - 25)

3.4.2 Characteristic damages (see pp. 16 - 25)

- Attacked wooden objects (e.g., picture frame; rafter; harrow, waggon, sculpture, table, etc.)
- Freshwood, drywood, dampwood
- Barked / debarked wood
- Openings and cavities regular (following annual tree rings; only sap-/heartwood; other forms; with other material added)

3.4.3 Antagonists (see p. 26)

Clerid beetles, ichneumonid wasps, braconid wasps, reduviid bugs, etc.

3.5 Timber species

- Softwood (Resinous wood) Pine, fir, spruce, larch, hemlock
- Hardwood (Non-resinous wood) Oak, beech, birch, aspen, ash, maple, walnut, elm,

3.4 Insects, their characteristic damages, and antagonists

3.4.1. Cerambycidae (Longhorn beetles)

House longhorn beetle (*Hylotrupes bajulus* (L.))

Adults: Body length 7 to 26 mm; females mostly longer; males with longer antennae; black (and/or brown) colour; prothorax with 3 „naked spots“; elytra with 1 or 2 distinct white bands composed of hairs
Larvae: Body length 2 to 35 mm; cylindrical body with constrictions; dorsal and ventral ampullae; body length 2 to 35 mm; ivory-white colour; one pair of 3 side eyes

Characters of damage and biology: Softwoods (resinous woods); only sapwood is attacked; forest insect, now „Culture follower“ (attack structural timbers in human dwellings); adult beetles do not feed; oviposition with long flexible ovipositor in cracks (and other openings); life cycle 2 to 10 years; emergence in June to August; normally ovoid emergence holes (size: 3..4 x 5..10 mm), mostly light coloured edges; thin surface cover („wall paper“); pupal chamber with larger fibrous gnawing particles; larval tunnels ovoid in cross-section; cylindrical fecal pellets, mostly light coloured bore dust.

Characteristic damages of House longhorn beetle (*Hylotrupes bajulus* (L.))

Blue tanbark borer (*Callidium violaceum* (L.))

Adults: Body length 8 to 15 mm; males with longer antennae; flat wider body; dark blue or violet colour, shiny; head and elytra punctuated
Larvae: Cylindrical larvae up to 27 mm long
Attacked wood species: mainly softwoods

Tanbark borer (*Phymatodes testaceus* (L.))

Adults: Body length 6 to 18 mm; males with longer antennae; flat, slender body; variable colour (red, brown, blue elytra; red, blue head and red pronotum)
Larvae: Cylindrical larvae up to 21 mm long
Attacked wood species: mainly hardwoods

Characters of damage and biology: Found in barked wood and barked timber; eggs oviposited in (cracked) bark; egg larvae gnaw through bark; further larval stages live between bark and sapwood; oldest larva gnaws a hook-shaped pupal chamber into sapwood; forest insect, sometimes in structural timber; life cycle 1 to 3 years; emergence in May to August; sharp edged, ovoid emergence holes (size: 2..4 x 5..6

mm); cylindrical fecal pellets; bore dust with different colours (light and dark particles depending on origin of bark and sapwood); no attack of dried unbarked timbers.

Characteristic damages of tanbark borers (*Phymatodes testaceus* (L.), *Callidium violaceum* (L.))

Red longhorn beetle (*Stictoleptura rubra* (L.))

Adults: Body length 12 to 22 mm; serrated antennae; elytra narrowing and tipped; females always longer, with red elytra and pronotum; in males yellowish brown and black, respectively
Larvae: cylindrical, up to 30 mm long

Characters of damage and biology: Dampwood insect in softwoods (resinous woods); often found in moist wood (stumps, poles, etc.), often with soil contact; often in timbers attacked previously by fungi; round and ovoid tunnels in softened wood; life cycle 2 years; emergence in May to August; circular emergence holes 5 to 7 mm; oviposition in cracks (and other openings); often mistaken with emergence holes caused by horntail wasps; adults often gathering on blossoming plants.

Characteristic damages of Red longhorn beetle (*Stictoleptura rubra* (L.))

Dusky longhorn beetle (*Arhopalus rusticus* (L.))

Adults: Body length 10 to 30 mm; females mostly longer; males with longer antennae; light- and dark-brown colour; prothorax with 2 longitudinal impressions; elytra with longitudinal ridges
Larvae: Cylindrical larvae up to 35 mm long; larvae with two minute rear thorns

Characters of damage and biology: Softwoods (Resinous woods); initially beneath the bark, later attack of sapwood and heartwood; forest insect, sometimes in structural timber; life cycle 2 to 3 years; emergence in July to August; sharp edged, ovoid emergence holes (size: 3..4 x 8..14 mm); pupal chamber with larger gnawing particles; larval tunnels ovoid in cross-section (with almost parallel longitudinal sides); cylindrical fecal pellets; bore dust contains longer fibres; bore dust stuffed in tunnels.

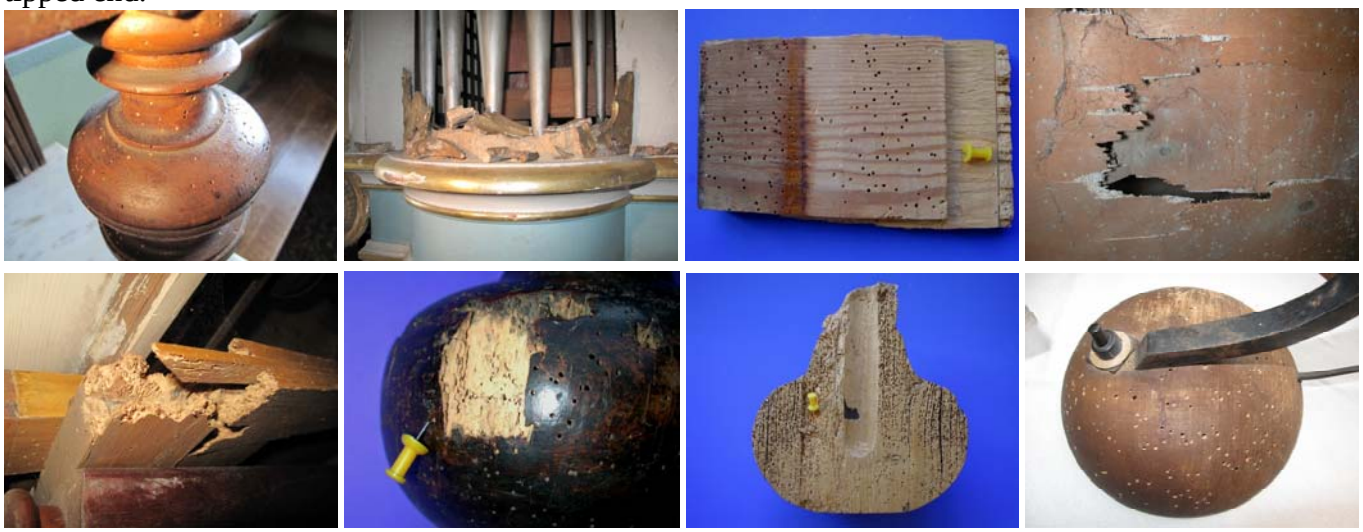

Characteristic damages of Dusky longhorn beetle (*Arhopalus rusticus* (L.))

3.4.2. Anobiidae (Anobiid beetles; “woodworms”)

Common furniture beetle (*Anobium punctatum* (De Geer))

Adults: Body length 2.5 to 5 mm; last three antennal segments elongated; brown colour; prothorax helm-like, with protuberance (lateral view); elytra with rows of punctations
Larvae: Body length up to 6 mm; white (ivory) colour; ventrally curved body (lateral view)

Characters of damage and biology: Found in softwoods and hardwoods; sapwood and heartwood is attacked; mainly in „old timber / objects“; oviposition in openings (cracks, tunnels, etc.); life cycle (1) 2 to 4 (5) years; emergence in April to August; normally round emergence holes (size: 1 to 2 mm); emergence not necessarily through freshly gnawed holes (use of old holes); larval tunnels irregularly distributed; larval tunnels round in cross-section; bore dust „timber coloured“; fecal pellets with one tipped end.


Characteristic damages of Common furniture beetle (*Anobium punctatum* (De Geer))

Deathwatch beetle (*Xestobium rufovillosum* (De Geer))

Adults: Body length 5 to 9 mm; last three antennal segments elongated; light-/dark-brown colour yellow patches of hairs; females larger; flat frontal part of head (tapping!!!)
Larvae: Body length up to 10 mm; ventrally curved, light-coloured, 3 pairs of visible legs

Characters of damage and biology: Found in hardwoods (mainly in oak; and softwoods occasionally); sapwood and heartwood is attacked; mostly in wood attacked by fungi; life cycle 2 to 6 (15) years; emergence in March to June; normally round emergence holes (size: 2 to 3.5 mm); males with tapping behavior; larval tunnels irregularly distributed, resulting in a sponge-like damage; larval tunnels round in cross-section (1 to 4 mm); bore dust „timber coloured“; emergence not necessarily through freshly gnawed holes (use of old holes); fecal pellets lentil-like.


Characteristic damages of Deathwatch beetle (*Xestobium rufovillosum* (De Geer))

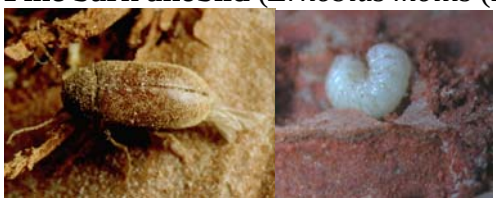
Dampwood borer (*Hadrobregmus pertinax* (L.))

Adults: Body length 4.5 to 6 mm; last three antennal segments elongated; dark brown to black colour; pronotum with medial protuberance and one lateral impression and group of yellow hairs on each side; elytra with longitudinal rows of deep punctations
Larvae: Body length up to 6 mm; ventrally curved body (lateral view)

Characters of damage and biology: Found in damp softwoods attacked previously by fungi; main emergence in early summer; overwintering in pupal or adult state; pupal chamber in softened timber; life cycle 2 or more years; feces rope-like; often associated with the common furniture beetle; wider round larval tunnels and emergence holes up to 3 mm in diameter.


Characteristic damages of Dampwood borer (*Hadrobregmus pertinax* (L.))

Pine bark anobiid (*Ernobius mollis* (L.))



Adults: Body length 3.5 to 6.5 mm; brown or reddish colour; smooth body covered with fine light hairs (not batch-like); pronotum softly sloped; last three antennal segments elongated
Larvae: similar to common furniture beetle (differences microscopically)

Characters of damage and biology: Found in barked wood and barked timber of softwoods; tunneling in bark and between bark and sapwood; often associated with tanbark borer species; characteristic short pupal chambers; circular emergence holes 2-2.5 mm; emergence in April to August; life cycle 1 or 2 years; fecal pellets lentil-like; bore dust with different colours (sapwood, bark); attack only up to 2 years after introduction into buildings – no attack of dried unbarked timbers.


Characteristic damages of Pine bark anobiid (*Ernobius mollis* (L.))

Fan-bearing wood borer; Tiny beetle (*Ptilinus pectinicornis* (L.))

Adults: Body length 3 to 6 mm; slender body; brown to black colour; darker pronotum softly sloped; females with serrated – males with comb-like antennae
Larvae: similar to common furniture beetle (differences microscopically)

Characters of damage and biology: Found in hardwoods (forest trees to artefacts); often in naturally dried timber stored for long years; circular emergence holes 1 to 2 mm; emergence in May to July; live in tunnels most of their life; emergence April to June; returning to tunnels for oviposition; tunnels normally filled with stuffed fine bore dust (striped appearance); life cycle 1or 2 or more years; female corpses often found near tunnel openings.

Characteristic damages of Fan-bearing beetle (*Ptilinus pectinicornis* (L.))

3.4.3. Lyctinae (Lyctid beetles; “powder post beetles p.p.”, Bostrichidae)

European lyctid beetle (*Lyctus linearis* (Goeze)) [Lyctinae (Lyctid beetles)]

Adults: Body length 2.5 to 5 mm; slender; (dark-)brown colour; pronotum with deep impression and punctations; elytra with longitudinal rows of punctations;
Larvae: curved ventrally, similar to common furniture beetle, but with stigma at rear body (only microscopical);

Characters of damage and biology: Found in hardwoods (mainly oak, locust tree, etc.); emergence in May to June; circular emergence holes 1 to 1.5 mm; life cycle 1 (to 2) year(s); oviposition in vessels, cracks, other openings.

Characteristic damages of European lyctid („Parquet“) beetle (*Lyctus linearis* (Goeze))

Brown lyctid beetle (*Lyctus brunneus* (Stephens))

Adults: Body length 3.5 to 7 (mostly 4-5) mm; light brown colour; darker pronotum with shallow impression; punctations fine (also on elytra)
Larvae: curved ventrally, similar to common furniture beetle, but with stigma at rear body (only microscopical)

Characters of damage and biology: Found in a multitude of imported and European hardwoods rich in starch and protein; only sapwood attacked; life cycle 5 to 18 months (up to 4 years); circular emergence holes 1 to 2 mm; emergence (all year around; starting mainly in early spring); oviposition as above.

3.4.4. Scolytidae (Scolytid beetles; “wood-boring bark beetles”; Scolytinae)

Broadleafed ambrosia beetle (*Trypodendron* (=*Xyloterus*) *lineatum* (Ol.))

Adults: Compact body; body length 3 to 3.8 mm; brown with striped elytra; pronotum coarse
Larvae: small larvae lacking legs

Characters of damage and biology: Freshwood (forest) insect with mass propagation; attacks softwoods (pine); parental beetles bore into fresh timbers (circular openings 1 to 2 mm) leaving characteristic tunnel systems with ladder-like sections; feed on symbiotic fungal mycelium (“ambrosia”); dried timbers with characteristic black-coloured tunnels of circular1 to 2 mm cross-section; young beetles emerge through original opening; tunnels of died-out beetles often found in structural timbers (boards, roof battens, etc.).

Characteristic damages of Broadleafed ambrosia beetle (*Trypodendron lineatum* (Olivier)) and European hardwood ambrosia beetle (*Tr. domesticum* (L.))

3.4.5. Lymexylidae (Lymexylid beetles; “timberworms”)

Timberworm (*Hylecoetus dermestoides* (L.))

Adults: Slender body; gender dimorphism; differently sized and coloured females and males (red, brown, 10 to 20; dark-brown, black, 7-12 mm); males with characteristic combe-like maxillae.
Larvae: Body length up to 25 mm; slender body with long spine-like structure at hint end; large pronotum

Characters of damage and biology: Freshwood insect, cultivating “ambrosia fungus”; attacks soft- and hardwoods; oviposition on bark; larvae gnaw through bark and tunnel in sap- and heartwood; long tunnels (up to to 30 cm); emergence in April to June (only few days); circular emergence holes up to 2.5 mm; timber often with large quantities of sectioned tunnels (often in oak); characteristic larval spine for expelling bore dust from tunnel system; life cycle 1 to 3 years.

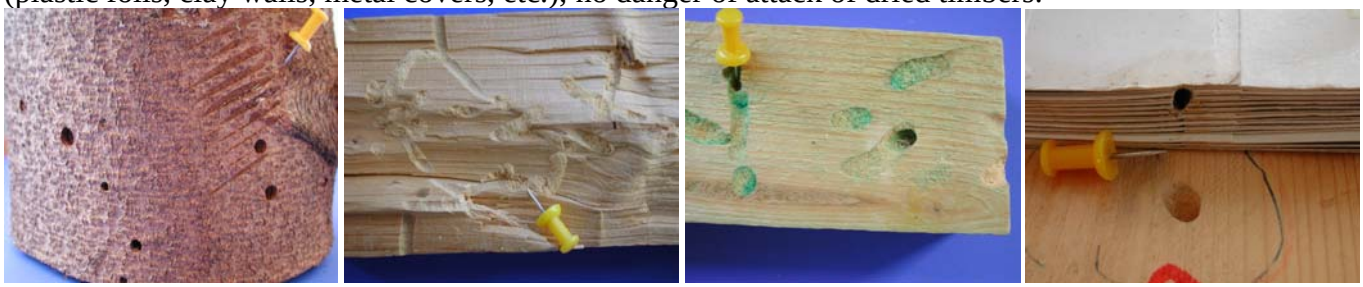
Characteristic damages of Timberworm (*Hylecoetus dermestoides* (L.)

3.4.6. Siricidae (Siricid wasps; horntail wasps)

Greater horntail wasp (*Urocerus gigas* (L.))

Adults: Body length and colouration different in sexes (gender dimorphism; males with reddish/black abdomen 12 to 32 mm long; females with yellow/black abdomen 14 to 45 mm , including ovipositor sheath)
Larvae: Body length up to 40 mm; light body sausage-like with small cuticular spine at rear end (“horntail”)

Characters of damage and biology: Freshwood (forest) insect with symbiotic white rot fungus; softwoods (standing trees or cut stems) are attacked; eggs oviposited through minute drill hole develop to large larvae tunnelling through sap- and heartwood; tunnels stuffed with wood-coloured fibrous bore dust; emergence in June to September; circular emergence holes 4 to 7 mm; life cycle 2 to 4 years; adults may emerge from build-in timbers (up to 2 years after introduction) and drill through covering materials (plastic foils, clay walls, metal covers, etc.); no danger of attack of dried timbers.



Characteristic damages of Greater horntail wasp (*Urocerus gigas* (L.))

3.4.7. Other families of wood-destroying insects

3.4.7.1 Ants (Formicidae)
Carpenter ant (*Camponotus herculeanus* (L.))
Adults: Body length 6 to 14 mm; black colour; red legs, thorax and frontal abdomen reddish.
Characters of damage and biology: Only chewing and gnawing of wooden materials in order to build nests (originally softwood trees; also structural timbers); predators, scavengers, feeding on honeydew; old at some time moistened timbers are preferred, new ones without moisture damage are gnawed on as well; gnawing particles may trickle and accumulate consistently (stem base or building section, respectively).

Shiny black wood ant (*Lasius fuliginosus* (Latreille))

Adults: Body length 4 to 5 mm; black shiny colour

Characters of damage and biology: Mostly in tree nests near buildings; intrude into buildings and nest in softened (formerly moistened), but also newly introduced timbers and interstitial building sections; including diverse insulation materials; carton nests formed with help of ascomycete; trickling and accumulating gnawing particles as signs of attack; damages in wood often with large cavities, often starting in early wood; leaving lamellae of late wood; winged alates emerging as early as April in heated buildings (other May to July).

Characteristic damages of ants (*Camponotus* spp., *Lasius* spp.; Formicidae)

3.4.7.2 Weevils (Cossoninae spp.; Curculionidae; *Rhyncolus* Germar and *Cossonus* Clairville spp.)

Adults: Head with snout; minute beetles, 2 to 4 mm long; brown or black colour; antennae with club
Larvae: Body length up to 4 mm; lacking legs; curved ventrally, light coloured

Characters of damage and biology: Adults and larvae feed on moist wooden materials, mostly previously attacked by fungi; formerly found in mines, today very often in buildings with previous water damages or leakages; initial damage with small holes (similar to emergence holes of small anobiid species); later surfaces with minute furrows and rotten areas becoming successively larger and crumbly; often late wood lamellae remaining.

Characteristic damages of weevils (Cossoninae spp.; Curculionidae)

3.4.7.3 Larder beetles (Dermestidae spp.; *Dermestes* (L.) spp.)

Adults (*Dermestes lardarius* L.): Body length 7 to 10 mm; antennae with club; dark (brown) colour; elytra frontally with grayish section with characteristic dots
Larvae: Body length up to 12 mm; yellow-brown colour; two minute spines

Characters of damage and biology: Larvae feed on organic materials (e.g., meat, mummified animals, wool); with mass propagation; bore into softened wood (previously infested by fungi) in order to pupate.

Characteristic damages of larder beetles (Dermestidae spp.)

3.4.7.4 Spider beetles (Ptinidae spp.) White marked spider beetle (*Ptinus fur* (L.); *Niptus* Boieldieu spp.)

Adults: Body length 3 to 4 mm; gender dimorphism (males slender, females spherical)

Characters of damage and biology: Larvae feed on organic material (i.e., food remainders of all kind); with mass propagation; bore into surfaces of timbers (mainly early wood) in order to pupate; pupation holes mostly sealed.

Characteristic damages of spider beetles (Ptinidae spp.)

3.4.7.5 Drywood termites (Kalotermitidae spp.; Cryptotermes brevis (Walker); Yellow-necked drywood termite (*Kalotermes flavicollis* (F.))

Adults: Body length up to 6 mm; light colour; different castes; alates emerging periodically; colonies with smaller numbers of members

Characters of damage and biology: Irregular gnawing in standing (dead) trees to wooden structures and artefacts (e.g. furniture); often large cavities, seldom tunnel-like structures; early wood preferred leaving lamellae of late wood; characteristic fecal pellets (dried peas).

Characteristic damages of drywood termites (Kalotermitidae spp.)

3.4.7.6 Subterranean termites (*Reticulitermesa flavipes* (Kollar); Rhinotermitidae spp.)

Adults and larvae: Body length up to 9 mm (queen); light colour, differently in castes; colonies with large numbers of members

Characters of damage and biology: Mainly feeding in trees, shrubs, other timbers in soil contact, structural timbers (wooden doors, windows, furniture); nests in soil (subterranean) and wooden objects; irregular cavities in wood, often with soil enclosures; surfaces mostly unharmed, early wood preferred, late wood lamellae remaining; galleries (superficial tunnels) containing different materials (timber, soil, dirt, etc.), feces soft.

Characteristic damages of subterranean termites (*Reticulitermes* spp.; Rhinotermitidae spp.)

3.4.7.7 Bee moth (*Aphomia sociella* (L.); Pyralidae)

Adults: Wing span 30 to 40 mm; gender dimorphism; grey to brown colour

Larvae: Body length up 13 mm; yellow with red-brown head

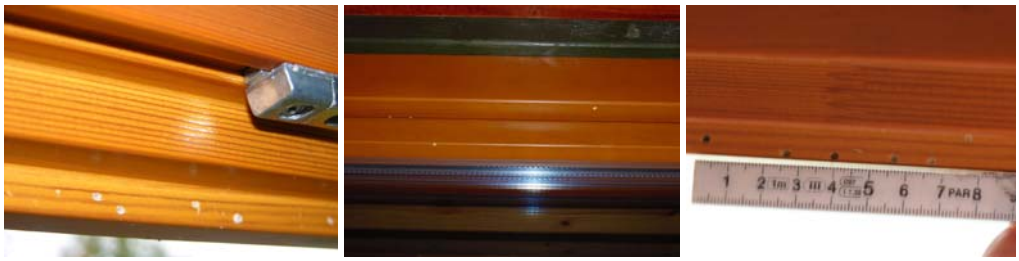
Characters of damage and biology: Found near nests of bumble bees and wasps; feed on organic materials in the nests; hundreds of eggs in one badge laid and similar number of cocoons formed; spun in small furrows gnawed by the larvae; pupation in cocoons; adults overwinter; superficial wood damages visible when cocoons are taken away.


Characteristic damages of the Bee moth (*Aphomia sociella* (L.); Pyralidae)

3.4.7.8 Dock sawfly (*Ametastegia glabrata* (Fallen); Tenthredinidae)

Adults: Body length up to 7 mm; black coloured body with light brown legs; shiny wings
Larvae: Body length up to 8 mm; light green ventral and lateral surfaces, dorsally darker; abdominal legs present

Characters of damage and biology: Usually living in stalk of plants (weeds with mass propagation); several generations per year; in autumn generation the final larval stages may search for material to pupate in; very often window and door frames (soft timbers) are gnawed on; pupation takes place in chamber in upper layers of timber; leaving damages especially in newly build houses; circular entrance hole 2 mm.


Characteristic damages of Dock sawfly (*Ametastegia glabrata* (Fallen); Tenthredinidae)

3.4.7.9 Wharf borer (*Nacerdes melanura* (L.); Oedemeridae)

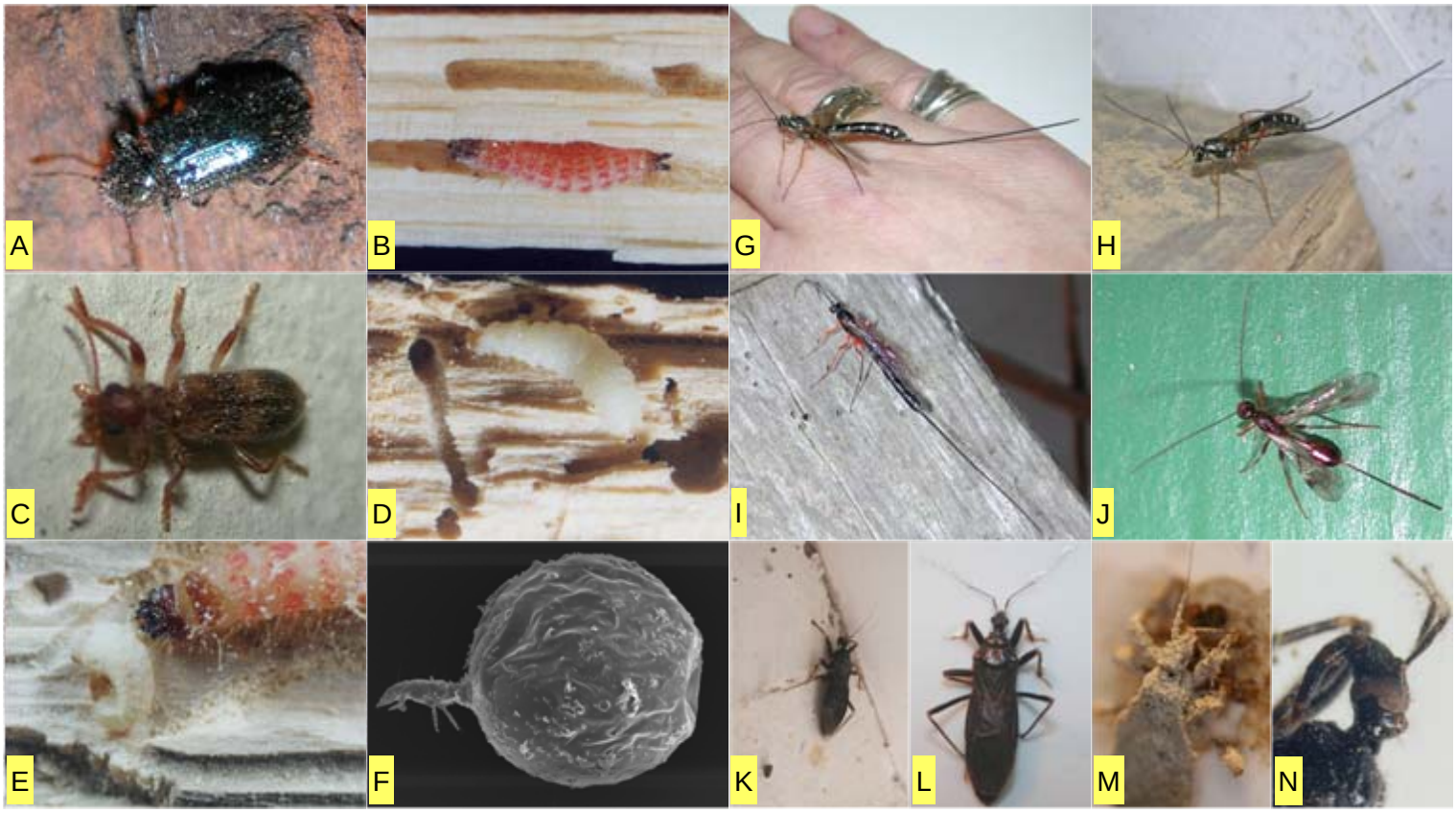
Adults: Slender body 9 to 13 mm long; soft yellow-brown elytra with black tips; thin antennae
Larvae: Body slender and constricted, body length up to 30 mm; three pairs of legs visible;

Characters of damage and biology: Attack of moist softwoods (regularly moistened, previously attacked by fungi); wooden materials with soil contact, ships (planks), constructions near water; life cycle 1 to 3 years; emergence holes ovoid (up to 5 mm, maximum width); emergence in May to June); larval tunnels filled with coarse bore dust, including longer fibers, and irregular fecal pellets.


Characteristic damages of Wharf borer (*Nacerdes melanura* (L.); Oedemeridae)

Antagonists of wood-destroying insects

Sites of attack, different species of spiders, and mode of attack (especially on adults of Deathwatch beetles)



A - E: Clerid beetles and larvae (Cleridae; Blue clerid beetle, (*Korynetes caeruleus* (De Geer)) and House clerid beetle (*Opilo domesticus* (Sturm)). – F: Grain itch mite (*Pediculoides ventricosus* Newp.)

G, H: Giant ichneumon wasp (*Rhyssa persuasoria* (L.)). – I: Ichneumon wasp (Ichneumonidae). – J: Braconid wasp (Braconidae, *Spathius* sp.). – K - N: Masked hunter (Reduviidae, *Reduvius* sp.)

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4. Monitoring measures (see pp. XX – XX)

4.1 Photographed, documented, assessed and then cleaned surfaces (for analysis of production and/or assemblage of bore dust)

4.2 Sampling of animals, specifically pest insects

4.3 Papers or cardboard as underlying measure (placed underneath areas of supposed insect activity)
- Papers and other materials of distinct colors (white; black; “anti-colored” papers with respect to timber color)
- Cardboards cards (white; black; “anti-colored” papers with respect to timber color)

4.4 Sticky traps (cover with vertebrate dense wires)
- Commercial sticky paper
- Commercial sticky traps
- Prepared insect glue on cardboard

4.5 Light traps
- Commercial light Traps
- Commercial lamps

4.6 Combinations of sticky traps
- Sticky traps and light traps
- Sticky traps and hanging devices (ladders, boxes, etc.)

4.7 Glued paper covers
- Wrapping paper
- Japon paper
- Teabag paper

4.8 Paper covers loose

4.9 Pheromone traps (species specific)

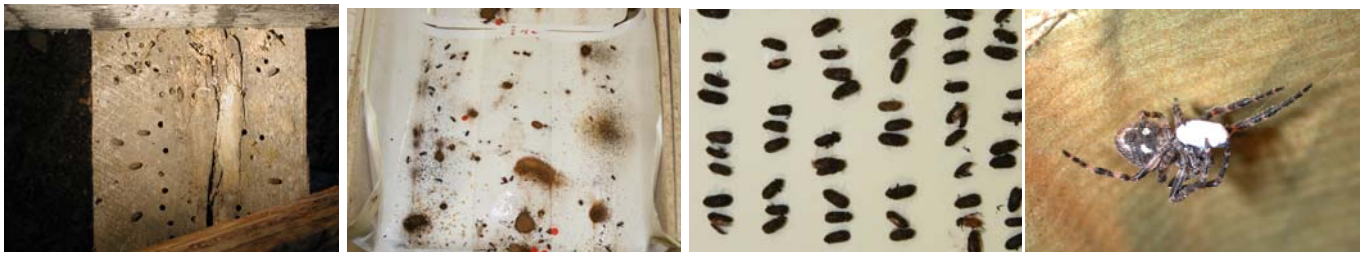
4.10 Sticky tape (place on surface of suspected object)

4.11 Sealing and quarantine

(Annex 10) Monitoring measures

1 Photographed, documented, assessed and then cleaned surfaces (for analysis of production and/or assemblage of bore dust)

2 Sampling of animals, specifically pest insects



3 Papers or cardboard as underlying measure (placed underneath areas of supposed insect activity)

3.1 Papers and other materials of distinct colors (white; black; “anti-colored” papers with respect to timber color)

3.2 Cardboards cards (white; black; “anti-colored” papers with respect to timber color)




4Sticky traps (cover with vertebrate dense wires)

4.1 Commercial sticky paper




4.2 Commercial sticky traps



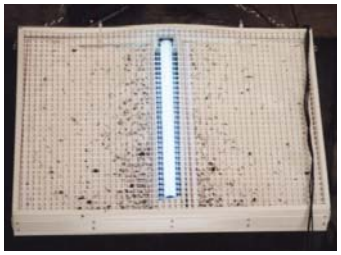
4.3 Prepared insect glue on cardboard




5 Light traps

5.1 Commercial light Traps




5.2. “Baulampen”




6 Combinations of sticky traps

6.1 Sticky traps and light traps



6.2 Sticky traps and hanging devices (ladders, boxes, etc.)





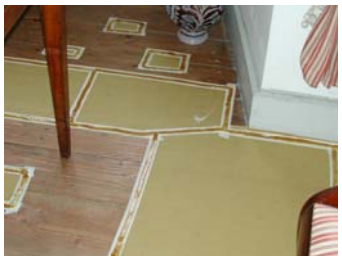
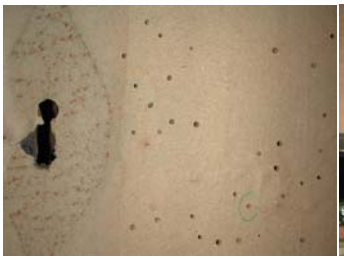
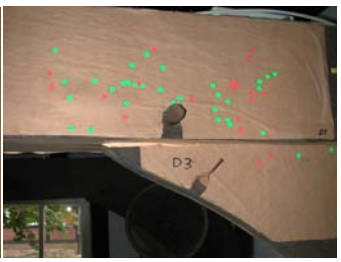


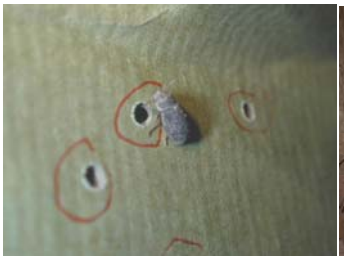




7 Glued papers

7.1 Wrapping paper

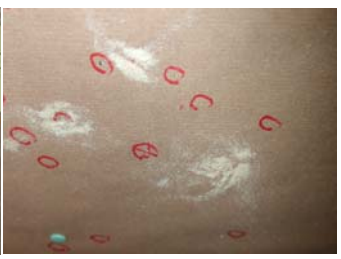




7.2 Japon paper

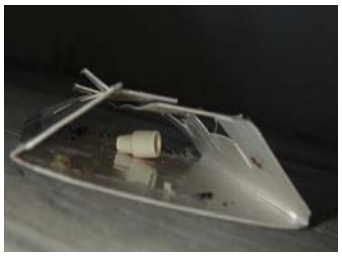
7.3 Teabag paper




8 Paper covers loose



9 Pheromone traps (species specific)

10 Sticky tape (place on surface of suspected object)




11 Sealing and quarantine