Partnership for the development of training standards for tree assessors in Central and Eastern Europe
PROJECT NUMBER – 2019-1-PL01-KA202-065670

TREE
ASSESSOR

Aerial tree inspection

Advanced tree assessment – manual for professionals

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Aerial tree inspection

Editor: Beata Pachnowska
Principal authors: Jerzy Stolarczyk, Beata Pachnowska, Jakub Józefczuk
Contributing authors and consultations: Agnes Buza, Andrzej Cichoń, Anna Pszkit, Kamil Witkoś-Gnach
Photos: Jakub Józefczuk/photo archive EKO-TREK, Andrzej Cichoń
Design and layout: Marta Płonka

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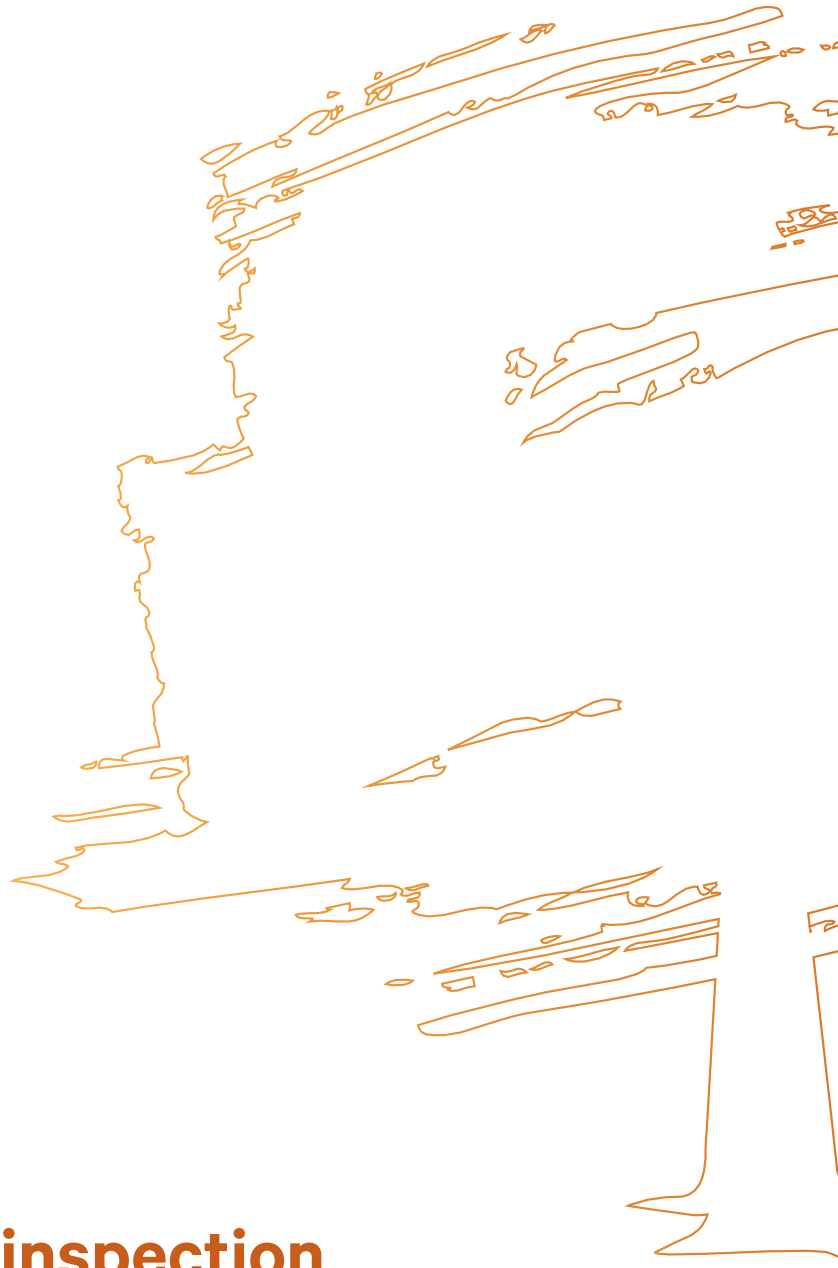

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Overview

This publication is a part of a set of materials for educating people involved in tree assessment, developed within the project under the abbreviated title of TREE ASSESSOR. The project aims to improve the quality and increase the effectiveness and efficiency, of vocational training for people dealing with tree diagnostics by developing a comprehensive training programme and educational materials for tree assessment. The project area of interest includes the countries of Central and Eastern Europe primarily. Still, the results of the project work are universal and can also be useful in other parts of Europe or the rest of the world. The set of materials for the training of people dealing with tree assessment developed within the TREE ASSESSOR Project includes:

1. BASIC AND ADVANCED TREE ASSESSMENT. GUIDELINES FOR TRAINING PROFESSIONALS.
2. BASIC AND ADVANCED TREE ASSESSMENT. MATERIALS FOR TRAINERS.
3. BASIC AND ADVANCED TREE ASSESSMENT. MATERIALS FOR TRAINEES.
4. BASIC TREE ASSESSMENT MANUAL.
5. ADVANCED TREE ASSESSMENT MANUAL.

This Aerial tree inspection manual belongs to a series of part 5 for advanced/specialist assessors.

IN THIS MANUAL YOU WILL FIND OUT:

1. Why is it worth performing an aerial tree inspection?
2. What information should be collected during an aerial tree inspection and how to use it in tree assessment and recommendations?
3. How to perform an aerial tree inspection?
4. What are the requirements for specialists performing an aerial tree inspection and how to cooperate with them?

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Introduction

Usually, most of the key diagnostic features for assessing tree stability, trunk condition and overall tree health are visible from the ground. However, in some cases, especially in the case of large and valuable trees with a large crown or visible from below signs of weakness or inhabitation, there is a need for a more detailed assessment or collecting additional data. When binoculars, focal length in the camera or satellite/ALS images are not enough (see the chapter on Remote tree control), the tree assessor should enter the crown or invite a tree climber – a professional arborist or climber trained in tree assessment, to perform a specialist assessment with climbing into the crown of a tree.

Photo 1.
Tree climbers know that you can see more from the top e.g. damage to branches invisible from the ground

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Differences and similarities in a crown inspection at both access levels were characterised by Stolarczyk and Józefczuk (2019) – see table 1 below.

An important aspect for aerial tree assessors is the possibility of obtaining data relevant to the assessment but not available from the ground.

	GROUND LEVEL TREE INSPECTION	AERIAL TREE INSPECTION
ASSESSMENT OBJECTIVE	Initial assessment/inventory Routine inspection. Basic assessment/inspection. Assessment of protections mounted in the ground/in the crown from the ground level.	Specialist assessment. Assessment of the risk of a part of a tree falling down or branches breaking. Problem trees, a decision to cut a tree down. Assessment of protections installed in the crown.
LOCATION	Roadside trees. Seldom used areas.	Frequently used areas. High risk for the surrounding area.
TIME/FINANCIAL INPUT	Lower. More unified.	Higher. More varied depending on tree characteristics.
TIME OF INSPECTION	It works especially well in the winter. Difficult assessment in the period of full foliage.	The whole year. Rope access is limited by difficult weather conditions, inhabitation by birds, protected species and stinging insects.
AGE/SIZE OF THE TREE	The only option for small and young trees. It works well with older trees without major problems and with a regular structure.	For bigger trees. Especially recommended for large and old trees, with problems in the crown visible from the ground, with mounted protections without markers or with non-standard ones.
BASIC DIAGNOSTIC TOOLS FOR CROWN ASSESSMENT	Limited possibilities of crown assessment. Only in a low based crown.	Yes, full crown assessment possible.
SPECIALIST DIAGNOSTIC TOOLS	Limited possibilities of crown assessment.	Yes, full crown assessment possible.
POSSIBILITY OF ASSESSING PROBLEM SPOTS IN THE CROWN	Limited. Lack of possibility of assessing upper parts of limbs and branches.	Yes, full. Possibility of very accurate assessments of the upper part of limbs, forks not visible from below, the scale of wood decay inside the limbs/trunks.
TEST SAMPLES (E.G. FUNGI, PATHOGENS)	Limited by the height of the samples to collect.	Yes, full.
ASSESSMENT OF INSTALLED SUPPORT SYSTEMS IN TREES (E.G. CABLING, ETC.).	Limited	Yes, full – including the assessment of rope tension, details of installation, degree of wear and collisions.
INVASIVENESS/DISTURBANCE AFFECTING ANIMALS LIVING ON THE TREE	Slight	Varied. When invasive, forgo.
QUALIFICATIONS OF AN ASSESSOR	Only for tree inspection	Above standard. Also for access to the crown (or with the help of a qualified climber/lift).
AWARENESS OF ORDERING PARTIES	High	Increasing

Table 1. Ground level and aerial tree inspections – comparison
Source: J. Stolarczyk, J. Józefczuk. „Diagnostyka korony drzewa". Presentation during the Tree Assessment Congress 2019 supplemented for the purposes of this publication.

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As indicated by the authors of ***Aerial Inspections: a Guide to Good Practice*** published by the Arboricultural Association in 2017[1], despite the fairly frequent practice of assessing trees from the level of the crown, until recently there were no clear guidelines on how to order, perform and save information on such assessment. Their proposal consists of detailed procedures and forms containing both elements specific only for the aerial as well as for the general tree inspection. Due to the fact that many of these elements were described and explained in detail in other ***Tree Assessor*** manuals, we decided not to duplicate them but focus on the specificity of assessing a tree relying on an aerial inspection. [General principles and objectives of tree assessment at the level of basic and specialised diagnostics can be found in other ***Tree Assessor*** manuals.]

It is worth emphasizing that aerial tree assessment, even if it covers the scope of basic tree diagnostics, is an advanced form of assessment and requires specialist competencies. Both ordering parties and contractors should take it into account when specifying the service and its price, clearly formulating expectations in this regard and anticipating correspondingly higher expenditure.

1 2017 Arboricultural Association. *Aerial Inspections: A Guide to Good Practice*

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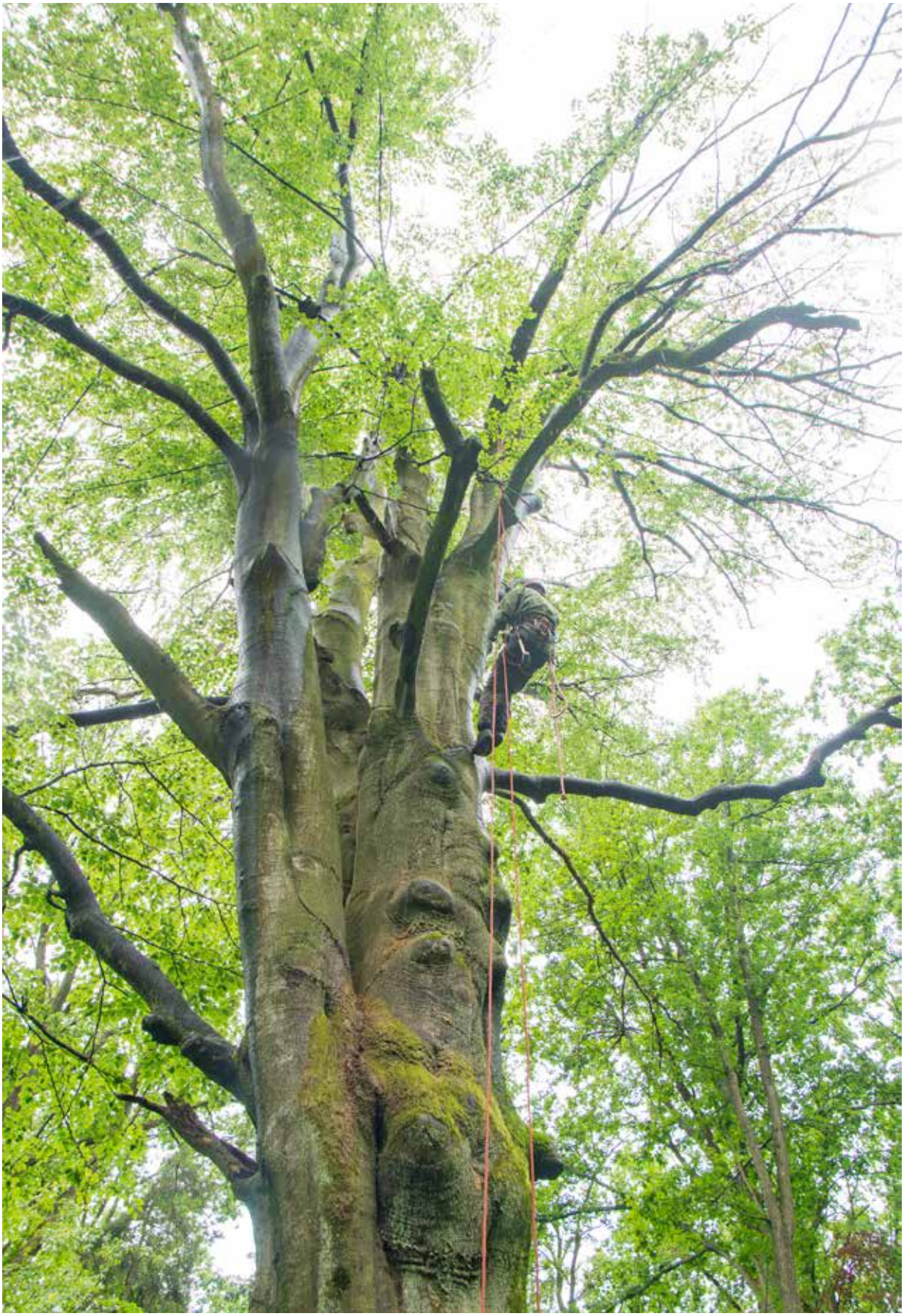

II.
Objectives of crown inspections

Checking upper parts of the tree may be the main objective of aerial tree inspection – in order to assess, examine, measure specific tree features or collect samples impossible to access from the ground level. Basically, it is possible to assess any aspect that is beyond the reach of an inspector's hands and tools at ground level. An aerial tree inspection may also be carried out while performing arboricultural work, e.g. inspecting/removing dead wood or pruning crown. Of course, it is necessary to state the purpose of such an inspection and ensure that contractors performing such a service are qualified for that.

Typical objectives of an aerial tree inspection are listed in Table 2. Most of them include complementary tree health and stability assessments performed from ground level, but for the upper parts of the tree. The exceptions is check of protective elements and inhabitation and biodiversity assessments – they are described in separate publications of Tree Assessor textbooks.

TYPICAL OBJECTIVES/AREAS OF ASSESSMENT:

- Condition
- Vitality
- Pathogens/organisms harmful to the tree
- Stability of part of the crown/assessment of risk of part of the crown falling down
- Tree response to pruning/reductions
- Instrumental assessment in the upper parts of the trunk/crown
- Condition of crown support prats or systems
- Inhabitation (protected species/biodiversity)

Table 2. Typical objectives and characteristics assessed in an aerial tree inspection.
Source: own work

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Photograph 2.
Examples of tree limb features invisible from ground level

As part of the health and stability assessment, almost any part of the tree can be inspected. Their list can be found in Figure 1.

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TRUNK/STEMS
• Detached bark • Cavities/hollows • Dead parts/tops • Cracks • Fruiting bodies of wood-decaying fungi • Insect prey/exit holes • Spots showing signs of previous cuts, their size and condition (overgrowing/decay) • Condition of the tree under climbing plants (if present) • Instrumental inspection of the condition of wood (e.g. with a sonic tomograph)
FORKS
• Included bark/wide mouthed bark inclusion • Cracks • Cup shaped union • Natural unions made of limbs or branches • Signs of kambiophages or caries (e.g. sawdust)
LIMBS/BRANCHES
• Limb damage/decay (especially from the top side) • Cracks (length/depth/ride height, fractured part stability) • Fractures/suspended broken branches and limbs • Fruiting bodies of wood-decaying fungi • Dead/dying • Rubbing/colliding branches • Reiterations competing with the main trunk • Spots where limbs were cut/reduced, the presence and stability of new shoot branches • Instrumental inspection of the condition of wood (e.g. with a sonic tomograph) • Shoots – assessment of vitality • Buds – recognition of species • Fruiting bodies of fungi
HOLLOWS/SHELTERS
• Size – dimensions of holes and their inside • Depth/thickness of the remaining wood wall (e.g. examined with a probe) • Wound wood/hollow overgrowing • Inhabitation – signs visible outside (e.g. faeces) and inside (e.g. live specimens/eggs, faeces) – **do not check with a probe unless you make sure there are no live specimens** • Work carried out in the past, e.g. removing rotten wood/protecting the inside with fungicides and their effects, e.g. cracks, chimney cavities in the trunk
PROTECTIONS
• Presence of protections and their description (in case of prior knowledge – inventory) • Assessment of the condition of protections – places of installation on the trunk, condition and tension of the ropes • Tree response to mounted protections • Collisions with other parts of the tree (e.g. ropes rubbing against branches)
BIODIVERSITY/INHABITATION OUTSIDE HOLLOWS
• Other living organisms on the trunk and branches (lichens, bryophytes, slime molds, fungi and invertebrates) • Nests (of birds, mammals or insects) • Signs of presence (also temporaly) protected species
PATHOGENS AND HARMFUL FACTORS
• Signs of pathogens and tree-damaging factors • Other characteristics/signs that may affect tree health, e.g. objects on the trunk such as tight cables
TARGETS/OBJECTS WITHIN THE CROWN OR IN THE COLLISION WITH THE TREE
• Objects under a tree, especially in the section of the crown – e.g. under a dead or broken branch • Objects colliding with the crown, e.g. overhead lines, roofs or street lamps

Figure 1. Typical characteristics assessed during an aerial tree inspection.

Source: own work

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III.
Collected data and inspection documentation

1. COMPLEMENT OF VISUAL ASSESSMENT

For the assessed characteristics, in order to complement the visual assessment in the ranges described in the previous points, one can perform:

- **Visual documentation – photographs, films as well as sketches and drawings of assessed parts of the crown and objects on the tree (e.g. nests).**

However, one should bear in mind that even the best photography distorts reality as it changes 3D into 2D and obscures parts of the crown. The use of sketches – even rough ones – right after descending the tree allows of a fairly accurate determination of the location of the noticed characteristics or their specificity. On the sketch, it is possible to note down the type of the characteristic, measurements, numerical designation of samples or the time of the assessment. One can also immediately describe possible solutions or expected difficulties.

TIP 1.

Show the scale of the observed characteristic on the photograph by placing another object next to it – a probe, tape measure, hand or pencil.

- **Measurements – height above the ground, distance from the trunk, size (e.g. size – length, depth).**

The measurement should be standardised and consistent with the more general standard adopted in tree assessment. When there is no such standard in a given country, one can rely on the following:

HEIGHT ABOVE THE GROUND LEVEL
In meters [m], rounded to 1 m
LENGTH/DEPTH
In centimetres [cm], rounded to 1 cm
For smaller parts – in millimetres [mm]
PERIMETERS AND DIAMETERS
In centimetres [cm], rounded to 1 cm
For smaller parts – in millimetres [mm]

Table 3. An example of standard measurement units
Source: own work

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In justified cases, it is possible to use the intervals and average the measurements.

- **Location data record – sides of the world/ geographical direction in degrees, location in the crown – e.g. level of forks, location in relation to another characteristic feature (e.g. a hollow).**

The location should be related to the marking of the assessed element, e.g. Hollow 1 at the height of 13 m on the North (23N).

- **Identification of the target/object within the range of the impact of the unstable part of the crown (stationary/permanent – difficult to move, as well as temporary ones, e.g. parking spaces, cars or playground equipment) with photographic documentation performed "from the top".**

The assessment should concern objects that exist on the day of inspection or that might be created on the plot where a given tree grows as well as on the neighbouring ones – for border trees (development of the neighbouring plot in the tree crown projection). It is also worth documenting other important elements visible from the top such as location conditions (e.g. watercourses and reservoirs).

- **Additional notes/remarks from the observation – written or audio recorded. It is also possible to record a video with a commentary.**

An aerial tree inspection can result in observations far beyond specification and additional assessments. When noted down or recorded, they will be very useful in later understanding of other data and their use in tree assessment.

- **Taking samples**

Samples should be taken as needed, but always in accordance with the provisions of the law, e.g. applicable regulations on protected species. This procedure requires preparation – one needs to have proper tools and containers to store the samples or safely take them down. The collected samples should be labelled (date, place, personal details of the person performing observation, tree species, etc.).

TIP 2.

As a rule, performing a tree assessment should not significantly change the baseline status of the tree, even when there are threats to the tree or its surroundings. In practice, during a crown inspection, even if it is not performed with the aim of doing something, it might be possible or necessary to intervene e.g. to remove a suspended branch. In such situations, unless clearly stated in the order, the action should be agreed on with the Ordering Party or the chief tree assessor, performed only when the person accessing the crown has appropriate qualifications and described in the tree assessment report (as it changes the condition of the tree). In other cases, in the event of threats requiring immediate intervention, the assessors should secure the tree and notify the Ordering Party or appropriate services responsible for eliminating such threats.

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2. ASSESSMENT OF TREE SUPPORT SYSTEMS

Detailed guidelines for the assessment of support parts or systems are described in a separate chapter of the Tree Assessor textbook. They can also be found in the "European Standard for Tree Security" prepared under the ERASMUS + TesT project[2]. Let us point out the aspects that are usually controlled:

- Type of support system
- Date of installing support elements
- Type of materials used
- Duration – whether it is adequate to the protected trunks/branches,
- Installing method
- Condition/damage (e.g. condition and tension of the rope, condition of shock absorbers, condition of straps)
- Impact on the tree (e.g. rubbing the trunk, branches, growing into the trunk).

The assessment also concerns the relation between the part of support system and the problem which it is/was supposed to solve (e.g. the existence of a problematic union in the case of damage to the crown or fracture of the protected branch part).

2 Project TesT "Technical Standards in Treework – TeST" – Trees cabling/bracing" ERASMUS + Project 2019-1-CZ01-KA202-061384

Photograph 3.
A crown inspection makes it possible to assess several aspects – limb, protection and potential inhabitation.

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3. INSTRUMENTAL ASSESSMENT ON TOP

Instrumental assessment with access to the upper parts of the trunk or crown is usually performed to check the level of wood decay using with a tomography and/or resistance drill. It is performed by a tree assessor or by a properly qualified assistant. The very process of assessment is similar to that performed on the ground level. The drill is easier to operate alone, but one should remember to properly secure it when accessing and using it at height. The tomography, due to many elements mounted on the trunk (sensors) or the use of the caliper, may require the cooperation of two people at height, and the transmission of data to the control unit may also be a limitation (e.g. Bluetooth range). It might be a good idea to use a mobile application instead of the software in the laptop and take the receiver (e.g. a smartphone) to the tree.

TIP 3.

As the authors of the aerial tree inspection by Arboricultural Association remind, "it is very important that all data are collected and recorded accurately and consistently. Inaccuracies can result in unnecessary tree work or removal, unexpected tree fall, loss of habitat, damage to property, or injury or death to people ".

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IV.
Access methods/techniques and tools as well as basic health and safety rules

An aerial tree inspection may be performed with the use of any access techniques appropriate to the target and location of the tree. When a tree is small or when elements to be assessed are located several metres above the ground and close to the trunk, it is usually enough to use a ladder (a lanyard may be used for additional protection), but for taller and larger trees it is necessary to use rope techniques or a crane. Each of these methods has its own advantages and disadvantages.

	ROPE TECHNIQUES • Unlimited access to the inside of the crown • Possibility of working in places with difficult access, • Non-invasive for trees **(the use of climbers/spurs is strictly prohibited on living trees)** • Low CO2 emissions but: • Requires tree access qualifications
	LIFT • Does not require any specific physical skills (apart from being allowed to work at height) but: • Difficult access to the inside of the crown • Possible soil compaction next to the tree • Often difficult access to the tree • Additional costs of equipment
	LADDER • No requirements as to tree access qualifications (possibly, a permission to work at a height of more than 3 m) • Works fine with smaller trees and for inspection close to the trunk but: • Unsuitable for large and tall trees • Difficult access to the external parts of the crown

Figure 2. Advantages and disadvantages of different access methods in aerial tree inspection
Source: own work with the use of J. Stolarczyk, J. Józefczuk. „Diagnostyka korony drzewa", presentation during the Tree Assessment Congress 2019, EKO-TREK/J. Józefczuk archive photos

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In order to ensure quick access to the crown it is possible to use a telescopic ladder – it is easy to transport even in a car. However, one should bear in mind that when using such a device a tree assessor should work together with an assistant and use basic personal protective equipment, e.g. a helmet, glasses and shoes with non-slip soles. People using ropes or a lift should follow the same health and safety rules as for other purposes of climbing the crown or working at height and possess appropriate qualifications (see point 5 below).
The assessment of older trees with hollows requires special attention as they may be inhabited by stinging insects – bees, wasps or hornets. Additional protection against insect bites – not only repellents, but also nets protecting the head and gloves – might also be useful during the season.

In addition to the access equipment and personal protective equipment, the person performing an aerial tree inspection should have a set of data collection equipment and tools for basic (and possibly instrumental) tree assessment.

Equipment may change according to the needs, but always remember to attach it properly to make sure it will not fall down from height. It is always a good idea to have spare devices or additional equipment that an assistant can send from the ground to the person working in the tree.

ASSESSMENT TOOLS
• An endoscope camera • A (rubber) diagnostic hammer • An arborist probe
EQUIPMENT FOR DATA RECORDING
• A smartphone or camera with a video option • A voice recorder • Note-taking equipment (a clipboard, notebook, pen and pencils)
MEASUREMENT EQUIPMENT
• A tape measure (DBH tape/a caliper be helpful too) • Equipment for measuring distance/height (rangefinder, hypsometer) • A compass • A ruler or another device for precise measurements
SAMPLING AIDS
• Garden shears/handsaw/knife • A small spatula, brush • Bags, sample containers and labelling aids
OTHER
• A torch/head torch • A small bottle of tool disinfectant • Disposable gloves

Figure 3. Equipment and tools useful in crown inspection
Source: own work

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V.
Aerial tree inspection contractor and their competencies

In many countries, there are clear guidelines/regulations that define the scope of required competencies for people working at height (especially in trees) and using specific access methods. However, such guidelines or regulations do not exist everywhere. Therefore, we decided to present the scope of competencies required to climb the tree crown and to perform basic or advanced assessment.

ACCESS COMPETENCIES	Rope access – tree climbing with the use of ropes with proficient belaying and positioning in the tree crown; Lift access – independent work from the lift or the ability to cooperate with the operator in the basket;
ASSESSMENT COMPETENCIES – BASIC	Knowledge and skills in the field of basic tree assessment and the use of appropriate tools;
ASSESSMENT COMPETENCIES – SPECIALIST	Knowledge in the field of natural sciences and protected species, extended knowledge about birds, lichens, fungi and other living organisms inhabiting the tree; Knowledge about tree support systems; Operating an instrumental assessment equipment;
EQUIPMENT OPERATION COMPETENCIES	Operating audio and video recording equipment; Operating measurement instruments or appropriate applications (e.g. a compass in a smartphone); Operating an endoscope camera; Collecting and securing samples;
COMMUNICATION SKILLS AND TAKING NOTES/ DRAWING SKETCHES	Skills of record observations and recommendations with words and/or images; Fluent language and vocabulary used by the chief tree assessor/inspector (especially important in international teams);

Table 3. Competencies of the tree assessor (performing an aerial tree inspection)
Source: own work

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VI.
Protection of trees and organisms inhabiting them, biosecurity and protection of the environment

Regardless of the fact what type of tree assessment is performed, it is vital to minimise its invasive character. The currently used assessment methods – especially at the basic level – are usually minimally invasive, but any interference on the part of the assessor may affect the tree or its inhabitants (living in its trunk, root system or crown). If this is not the purpose of the tree access, one should not damage, eliminate or destroy anything in the habitat, even though specific living organisms – from our point of view – have a negative influence on the tree.

Photograph 4.
A nest of a finch in a broken tree limb invisible from below.

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THE FOLLOWING TIPS MAY BE HELPFUL:

- During tree assessment use non-invasive access methods, and when using the rope – techniques and equipment protecting tree bark and cambium.
- In the case of trees with lichens, minimise contact with the trunk or branches – many of them are protected species.
- During instrumental assessment, minimise interference with tree tissues, e.g. when using a resistance drill, make only the necessary holes significantly improving the quality of the assessment.
- Before using the probe in hollows or cracks, check for possible inhabitation, in holes also by using an endoscope camera. Pay attention to large holes as they might be inhabited by bats in winter, including the smallest ones.
- Take samples only when the photographic documentation and measurements are not sufficient, make sure that a given specimen does not represent a protected species, and – if yes – that the sample taken can be collected or transferred. Follow the principles of biosecurity – disinfect tools, including needles of tomography sensors, shoes and hands – especially when there are concerns about the transmission of pathogens.
- Secure the equipment from falling, and while working in the crown, secure the area from unauthorised access and the consequences of even small parts of the tree falling.

Photograph 5.
Before using the probe, make sure the hollow is not inhabited by birds or mammals.

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VII.
Specification and cooperation with an inspector/tree assessor working from the ground level

An aerial tree inspection performed in order to complement ground level assessment/to check specific parts of the tree and delegated to a person other than the tree assessor should be clearly specified. The objectives of the assessment should be defined as precisely as possible, according to the experience and knowledge of the assessor working in the crown, specifying its location and initial scope. It is worth adopting the rule that the less experienced the assistant, the more precisely the scope of work in the crown should be defined. Of course, it is always possible to communicate on an ongoing basis during the assessment procedure and complete the scope of the assessment in line with current findings.

EXAMPLE 1.

While assessing the tree from the ground level, the assessor noticed fungal fruiting bodies and a hollow in the main trunk at a height of about 13 m from the east. An aerial tree inspection will allow him or her to prepare photographic documentation helpful in marking the species of fungus, to assess the condition of the trunk (with a probe or a hammer) to measure the hollow (if necessary) and to check whether or not it is inhabited.

ASSESSMENT SPECIFICATION:

Check the position of the fruiting body on the main trunk at a height of about 13 m from the east. Take at least 2 photographs of the fruiting body and the area around it. Check the health of the trunk in the place where the fruiting body grows. First, check the hollow for any signs of inhabitation. If it is not currently inhabited by any birds or mammals, measure the depth of the hollow and the thickness of the remaining tree wall (with a probe and measuring tape). Hit the area of the fruiting body with a hammer, above and below it, to check the tree for any decay. Check the health of the trunk with a probe. Use an endoscope to assess the inside of the hollow. If it is large enough, check the content of the hollow for the presence of protected species (if possible, take a sample of rot). Take photographs of the hollow and its inside as well.

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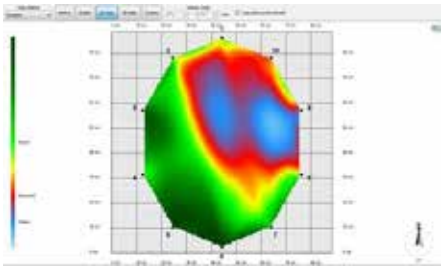
Such a specification may also include more general objectives, for instance, checking all major forks or assessing the stability of new branches with the diameter of over 10 cm growing from former reduction limbs or stems.



Photograph 6.
Instrumental crown assessment makes it possible to assess the health of the trunk and the limb inhabited by the fungus.

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EXAMPLE 2.

An assessor examines a poplar which was reduced around 15 years ago at a height of 10-12 m. An aerial tree inspection will allow him/her to assess the condition of spots after pruning (especially at the ends of previous trunks), their decay and the condition of spots with new branches.

ASSESSMENT SPECIFICATION:

Check the condition of the ends of all pruned limbs – decay/cavities, condition of the remaining walls. Take photographs of each examined limb – from the side and from the cut, and new branches emerging from the spots where the tree was cut.

Photograph 7.
Aerial tree inspection helps an assessor to examine the condition of pruned tree parts and limbs in places invisible from the ground level.

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Partnership for the development of training standards for tree assessors in Central and Eastern Europe
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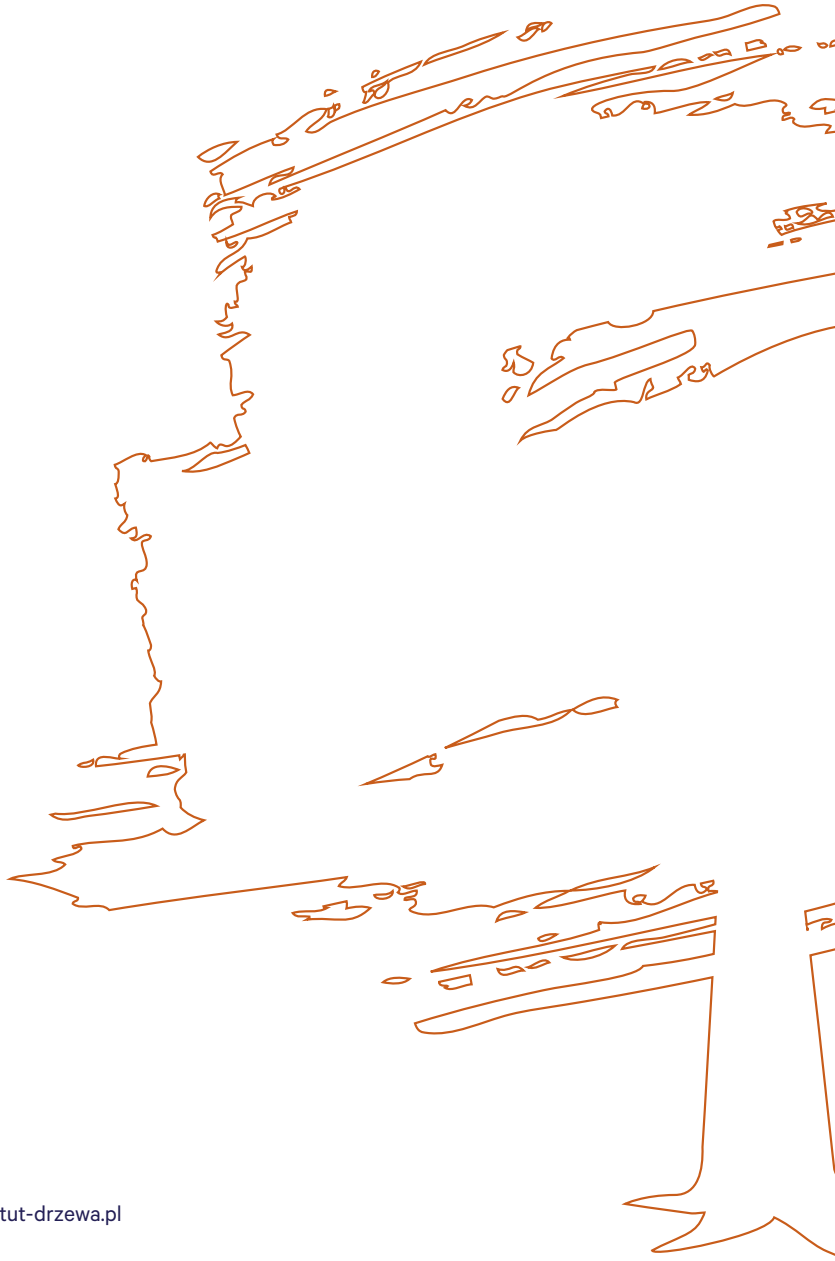

Instytut Drzewa Sp. z o.o.
www.instytut-drzewa.pl
tel.: 789-032-424, e-mail: biuro@instytut-drzewa.pl

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