



Ecosystem services of trees in settlements



Inspiring for production of
an educational tool



Erasmus+

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1. Why educate about the importance of trees in settlements

Trees have been associated with human life throughout the history of our species. It is an extremely broad topic, which has been the subject of many texts and books. From the point of view of today's most serious global environmental problems (climate change and biodiversity loss), let us state at least the following. Each tree affects the microclimate, absorbs carbon from the atmosphere and helps to retain water. It creates conditions for the life of other plants, animals, fungi and microorganisms. Every tree is part of an ecosystem that is important for our lives.

In particular, the professional public has good-quality information about the various functions of woody plants in the environment where they grow – the so-called ecosystem services. Science is constantly advancing this information with new discoveries and findings. At the same time, it is important that information on the importance of woody plants is conveyed in a meaningful way to the public. At a time of growing interest in planting trees in the environment human settlements or more broadly – wherever they are most needed, this topic is extremely actual.

2. What information to provide to the public?

Public awareness of the importance of woody plants is generally high for some topics (e.g., oxygen production), but relatively low for others (importance for water retention and importance for biodiversity). In this document, we would like to offer you an overview of several topics you can use to educate the public about the importance of woody plants – or in other words, on their ecosystem services. Above that we use the oak tree as an example on how this specific tree species relates to biodiversity – i.e., other specific plant species, animals, fungi, and other organisms.

1.1. Trees and ecosystem services

Water retention by a tree canopy

Not all raindrops that fall on a tree will fall to the ground. During the first minutes of rain, the water is trapped in the crown on the leaves and branches, from where it later evaporates. In this way, a deciduous tree "processes" up to 15-25% of the annual total rainfall. Since this water does not run off the surface, the trees help protect against floods.

Protection against wind, noise and sunlight

Trees are protective barriers. Their wind breaking function has been known and used for a long time, especially in the flat country. A dense strip of trees 10 m wide will significantly reduce the wind speed and reduce the sound level by 1 to 6 dB. A dense forest 30 m wide can reduce noise by up to half. We use the shade provided by woody plants to create recreation areas, but also as protection against overheating of buildings in the summer.

Cooling of the environment in hot weather

Properly planted vegetation can effectively cool the local climate. In addition to providing shade, trees are exceptional for their active ability to cool the environment. As a result, the average tree evaporates up to 400 l of water during the summer day and at the same time consumes almost 280 kWh of thermal energy from the air. The vegetation thus significantly cools the surroundings on days when there is an excess of sunlight. The differences in air temperature in the environment with and without trees reach 6 – 9 ° C.

The trees generally stabilize the climate. Conversely, if the temperature drops, water vapor condenses into liquid water, which can increase the ambient temperature by up to 3 ° C.

Excretion of organic substances beneficial to health

Trees and shrubs excrete various substances into the air, either in their communication with other organisms (for example, the scent of flowers attracts bees and other pollinators) or for their own protection – substances called phytoncides have an antimicrobial effect. Breathing air in a woody environment is also beneficial to us, the people. A walk in a forest environment has a demonstrably beneficial effect on normalizing blood pressure, increasing lung capacity and vascular elasticity, and overall has a positive effect on our psyche.



Humidification and oxygen production

1 ha of forest land during the summer day produces an amount of oxygen, which corresponds to the consumption of about 38 people. Or smaller, one large tree produces about a thousand litres of oxygen during full day light, which is enough for about 10 people.

Another substance that trees release into the environment in large quantities is water. On average, a large tree evaporates up to 400 litres of water per day. Trees on an area of 1 ha release about 25 m³ of water into the air in summer. Thus, forests make a significant contribution to the formation of clouds and precipitation – without them, the continental hinterland would be much drier a few hundred kilometres from the coast and would turn into deserts and semi-deserts.

Capture of substances: dust and gases

Trees are powerful air "cleaners". They capture dust particles, but also various gaseous substances, including harmful substances that have been released into the air by human activity (e.g., organic substances, nitrogen and sulfur compounds). Thanks to its large total leaf area, 1 hectare of forest captures up to an incredible 77 tonnes of such foreign matter per year.

Trees also absorb carbon dioxide during photosynthesis. One tree stores up to 22 tons of carbon dioxide in its trunk, branches, roots and leaves (which become part of the humus in the soil) during its lifetime. Healthy forests are therefore extremely important in the effort to save the Earth's climate.

Improving soil quality and supporting soil life

Forest land is an incredibly complex and rich ecosystem. Bacteria, fungi, algae, protozoa, nematodes, tardigrades, ringed worms, mites, springtails, crustaceans, millipedes, ants, and other groups of organisms live here. The life cycle and humus production are "driven" mainly by deciduous trees, as fallen leaves are the primary source of nutrients for soil organisms. Life in the soil is also supported by the root system of the tree – it creates suitable conditions for water infiltration and retention, and coexistence (mycorrhiza) with fungi is also important.

The forest land can contain more living organisms than there are people on earth, and we still have many inconspicuous but significant discoveries in this area.

Rainwater infiltration

Rainwater drips and flows to the ground only after soaking the leaves and branches. Thanks to its structure, the tree slows down the water and significantly improves its infiltration and retention in the soil. It is the root system that makes it possible. The living and decaying roots of the trees form a system of well-connected canals through which water flows several hundred times faster than through a layer of just soil of the same quality. Soil humus created from fallen leaves and dead roots or by the activity of various soil organisms, also helps water infiltration. Trees are therefore an important part of water retention measures in the country.

1.2. Trees and biodiversity

The interconnection of trees and biodiversity is illustrated by using the example of the relationship of oak to other domestic species of animals, plants, fungi, and other organisms.

Examples of organisms for placement on a tree:



Fungi

Beefsteak fungus (Fistulina hepatica)



Lichens

Ramalina farinacea



Plants

European lorch (Loranthus europeus) – grows most often in oaks moss – e.g., broom forkmoss (*Dicranum scoparium*)



Invertebrates

European stag beetle (Lucanus cervus)
European rhinoceros beetle (Oryctes nasicornis)
Great capricorn beetle (Cerambyx cerdo)
European oak borer (Agrilus sulcicollis)
Common cockchafer (Melolontha melolontha) *marble gall wasp (Andricus collari)* – e.g., with a leaf and a gall
Camponotus vagus – a species of the carpenter ant group





Vertebrates

Fire salamander (*Salamandra salamandra*) – placed among roots
Eurasian nuthatch (*Sitta europaea*)
marsh tit (*Parus palustris*)
Eurasian blue tit (*Cyanistes caeruleus*)
European robin (*Erithacus rubecula*)
middle spotted woodpecker (*Dendrocopos medius*)
green woodpecker (*Picus viridis*)
Eurasian jay (*Garrulus glandarius*)
tawny owl (*Strix aluco*)
European edible dormouse (*Glis glis*)
European pine marten (*Martes martes*)



Microorganisms

Several organisms together in one part (placed to the roots) – pictures of representatives of bacteria, actinomycetes, microscopic fungi, protozoa, mites, nematodes.

2. In what way (by what tool) to convey this information?

resentation of basic technical options of preparation of this tool and mediation of experience with its implementation in practice

The above information can be "transformed" into a specific educational tool, while there are naturally several technical possibilities. In any case, we consider the possibility of manipulating individual smaller elements, which represent or represent individual ecosystem services and organisms, to be a key feature of the tool. Velcro, hooks, magnets, rotating parts, etc. can be used for this purpose. The material options for preparing the tree model itself are also varied – for example, wooden elements, textiles or metals can be used and combined.

At the Ekopolis Foundation, we decided to use plywood as the base on which the silhouette of solid wood oak is placed. Also moving parts (ecosystem services and organisms) are presented on the same plywood material.

Moving elements (ecosystem services, organisms) are handled differently:

- information on **ecosystem services** is located on rotating parts (a total of 8 panels). One of their sides is an organic part of the drawing and after their rotation information on a specific ecosystem service is presented in the form of text supplemented by infographics (see the picture):



- specific organisms are drawn on plywood elements (a total of 22 pieces), which can be placed on the tree thanks to magnets – these are inserted into the back of the element and into the wooden model of the tree (see the picture):



- elements with organisms can be stored in a bag in the “hollow” in the middle of the tree (see the picture):



To improve the work with the tool, the following solutions are also part of the technical design:

- the upper part of the tool with the model of the tree and the drawing is 3-part and can be folded and closed, which greatly facilitates the transfer;
- the overall design includes 3 cabinets on which the tool can be placed and stabilized - this also achieves a suitable height for its use;
- the tool can also be placed separately on the wall by attaching it to a solid hook, thanks to which it will serve as a part of the interior or decoration in suitable spaces.

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