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OLTRE IL GIARDINO

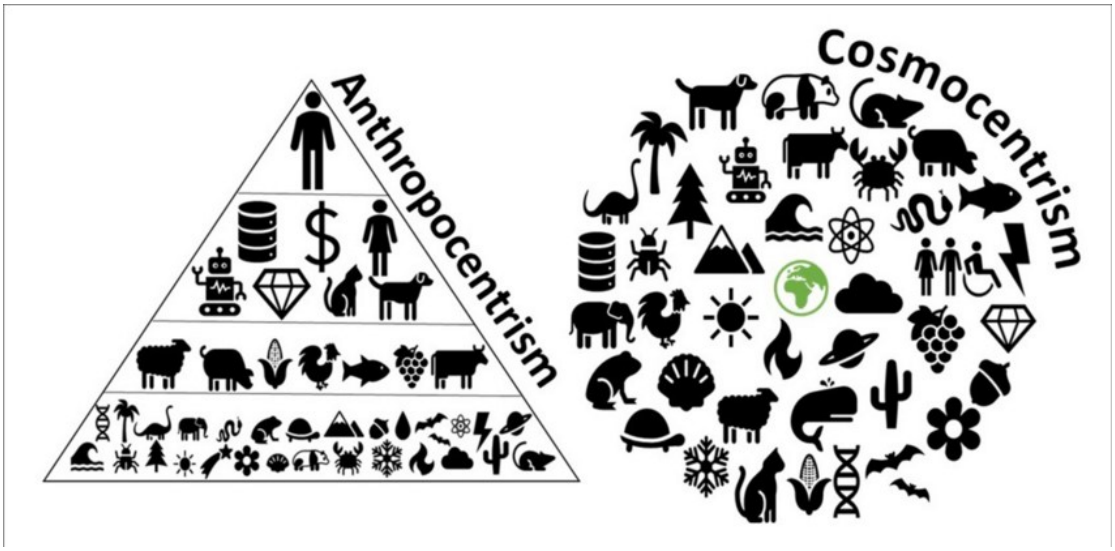
BIODIVERSITY AND URBAN ECOLOGY

Educational material for the workshop:

"Biodiversity and Conservation of Historic Gardens",

in the framework of the European Project Erasmus+

"Oltre il Giardino - Social Inclusion Observatory".



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Agricultural University of Athens

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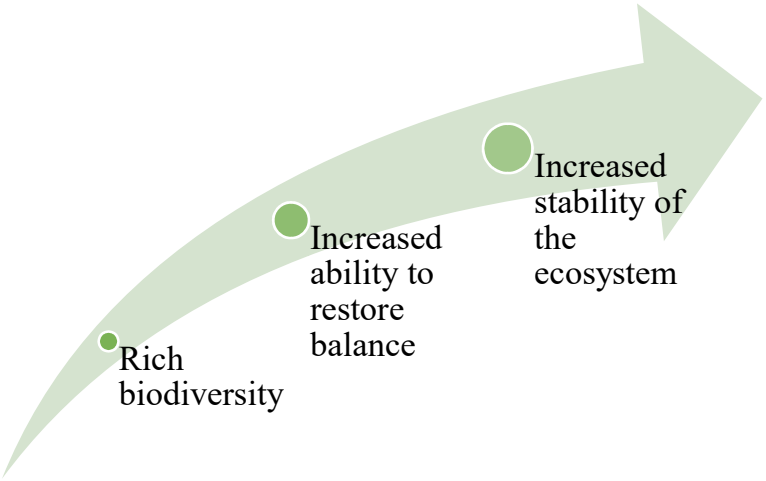
Biodiversity

Biodiversity, or biological diversity, is the diversity of living organisms of all origins, including, species from terrestrial, marine and other aquatic ecosystems and ecological complexes of which they are a part.

Simply put, biodiversity is the diversity of life in all its forms (plants, animals, fungi, etc.) and at all levels of its organization (genes, organisms, ecosystems).

There are usually four levels of biodiversity: genetic biodiversity, species biodiversity, landscape biodiversity and ecosystems biodiversity.

An ecosystem with rich biodiversity is considered to be more stable.

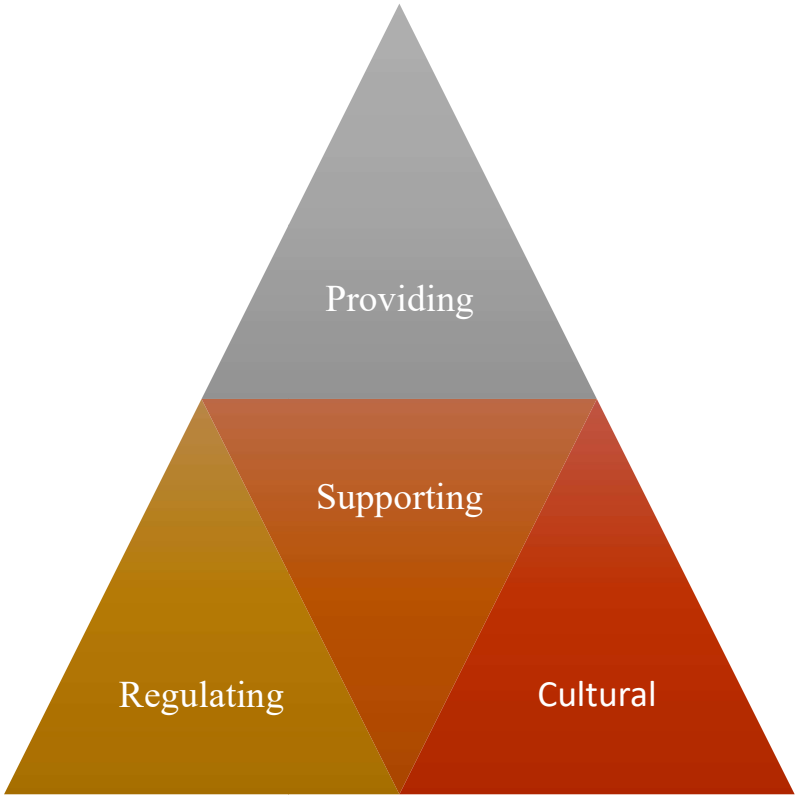


Also, rich biodiversity is responsible for more ecosystem services.

Ecosystem Services

- Ecosystem services are considered all the benefits that humans receive from ecosystems.
- The term has been widely used in recent years to emphasize the importance of nature (and biodiversity) in human life, as it is now clear that human well-being depends on ecosystem services.

- This idea differs from previous ecological approaches to ecology because it offers a holistic and intergrated view that emphasizes the relationship between different ecosystems and in relation to human activity and also determines the economic values of specific ecosystems.
- Distinguishing and categorizing ecosystem services is difficult but an effort is being made towards this direction, as the term is now used – among others - in policy making.



<u>Ecosystem Services of Urban Green Spaces</u>

1. Nature Conservation.

The relationship between cities and nature is a key challenge for nature conservation in cities but also for the future of wildlife. The ecological footprint of cities indirectly affects ecosystems both locally and globally.

2. Enhancement of biodiversity

- Green spaces in cities enhance biodiversity.
- Large urban centers act as inhibitors for biodiversity, both for animal and plant species. In recent years, however, it has become clear that carefully designed urban green spaces can act as centers for habitat protection and biodiversity enhancement.
- They offer a link between urban areas and the countryside, as they function as green passages or even as urban forests.
- A functional network of green spaces is important for the preservation of the ecological parameters of a sustainable urban landscape.
- Green spaces can function as innovative habitats that may differ from the classic motifs but support a large number of species
- Sustainability is ensured if plant species adapted to local conditions are used with low maintenance costs, self-sufficient and sustainable.

3. Improving the urban climate.

- Urban areas have higher air and surface temperatures compared to their neighboring areas, mainly due to increased coverage with building materials such as asphalt and cement.
- Structured surfaces are characterized by high heat storage during the day. This heat is emitted during the night causing a phenomenon called urban heat island.
- Air pollution and anthropogenic heat sources enhance the heat load within the urban area.
- Green spaces have been shown to reduce this phenomenon and improve the quality of life. Vegetation cools the environment through energy-consuming evaporation, shading that retains sunlight and its thermal properties.
- The size of the green space as well as the species used can further improve the climate.

4. Improvement of air quality.

- Vegetation in urban areas has a positive impact on air quality as it contributes to both the reduction of pollutants and the absorption of carbon dioxide.

- The air in cities contains various pollutants, and their negative impact on the health of citizens is increased by the high temperature.

- • This pollution is indirectly associated with health problems and unusually high levels of death and morbidity among city dwellers.

5. Noise reduction.

- Noise pollution from traffic and other sources can be stressful and create health problems for city dwellers.
- The total cost of noise is estimated to range from 0.2% to 2% of the gross domestic product of the European Union.
- Urban green spaces in busy cities can greatly reduce noise levels (depending on their quantity, quality and distance from the source of noise pollution.)

6. Decontamination of soil pollutants.

- Heavy metal pollution and industrial waste are a long-term concern, especially in industrial cities.
- The use of plants for bioremediation or restoration of contaminated soil and groundwater, removal of toxic substances and degradation, is defined as plant restoration.
- Vegetation can remove pollutants efficiently and economically, while providing the benefits of a green environment to those living near contaminated areas.

7. Energy saving.

The use of vegetation to reduce the energy cost of cooling buildings is increasingly recognized as cost-effective. Plants improve air circulation and provide shade. This creates a cooling effect and helps to reduce the air temperature.

8. Increasing the value of real estate (financial benefits).

Areas of cities with plenty of green spaces are aesthetically pleasing and attractive to both residents and investors. Green spaces and landscaping increase property values and economic returns for builders.

9. Leisure and well-being.

People meet most of their leisure needs close to where they live. Urban green spaces are offered for relaxation and provide well-being.

10. Health.

- Human health and well-being can be considered as the ultimate or cumulative ecosystem service. The presence of green space with sufficient biodiversity in urban centers is associated with enhancing the quality of life of residents.
- Natural locations seem to be able to enhance psychological well-being by reducing psychosomatic stress, evoking positive emotions. It has been observed that the longer a person stays in the natural environment the more they describe as a better sense of well-being and recovery.

<u>Biodiversity of Attica</u>

- Among the regions of Greece, Attica is characterized by rich biodiversity, a fact that contradicts the daily experience of citizens.
- The value of the biodiversity of Attica is evident from the fact that in the area hosts two National Parks and 7 Natura 2000 sites.

Attica hosts the mountains Hymettus, Parnitha, Penteliko and Egaleo / Poikilou Oros, and important wetlands that are centers of biodiversity.

- Hymettus is now an urban forest and Natura 2000 Protected Site.
- More than 600 species and subspecies of plants are found in the mountain, of which 54 are endemic to Greece, while 59 are protected by law or are included in lists of endangered species. The biodiversity of birds is also important, as more than 100 species have been recorded,

including quite rare species (eg hawk, peregrine falcon, eagle owl, etc.), which are protected under the Wild Birds Directive (79/409 / EEC). In Hymettus, there are also two species of turtles, a species of snakes and two species of bats that are protected under Directive 93/43 / EEC. Bees are also of particular importance.

- Parnitha is located close to the urban area, is designated as a National Park and has been included in the Natura 2000 Network.

- It is characterized by rich forests of Abies cephalonica and other conifers. There are 1,116 plant taxa in Parnitha, three of which are exclusively endemic to the mountain. There are 158 species of birds, of which 28 are included in Directive 79/409 Annex I, 102 species are included in the Berne Convention Annex II, 58 species in the Bonn Convention and 18 species in the Greek Red Book of Endangered Species. There are also 39 species of mammals, 25 of which are included in the Red Book and 32 in the Berne Convention. Finally, 29 species of reptiles and amphibians have been recorded, of which 24 species are included in the Berne Convention and 4 in Directive 92/43.

- Archaeological sites

Archaeological sites usually appear as islets of wildlife as minimal human intervention in the area favors this phenomenon.

In the area of the Acropolis are found various species of birds and invertebrates, as well as rich flora. The most important plant species is considered to be *Micromeria acropolitana*, a narrow endemic species that grows only on the hill of the Acropolis.

Urban Ecosystem

- A whole city can be considered an ecosystem.
- In another approach, the city can be considered a set of smaller ecosystems.
- In a city some semi-natural ecosystems can be found:
  - Arrays of trees on the sidewalks.
  - Parks, sports facilities (eg golf courses).
  - Urban forests / groves.
  - Arable land.
  - Wetlands (eg swamps), rivers, lakes, sea, streams.
  - Gardens and yards.

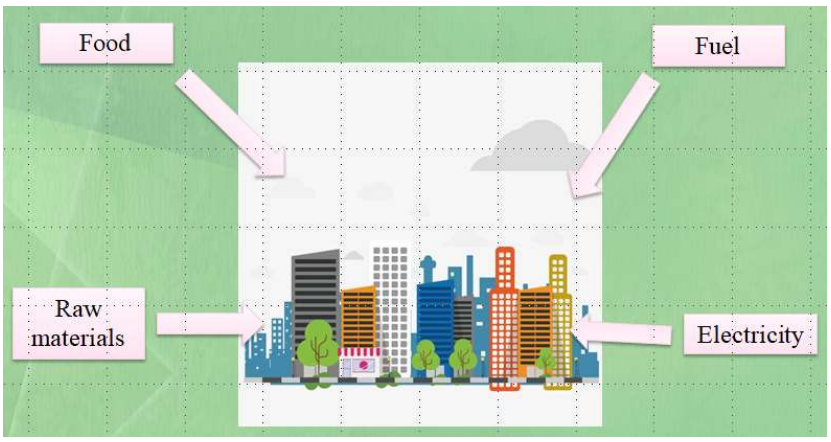
It is a fact that in the urban areas there are some oases of greenery, with special flora and fauna, which together with the buildings and the streets have replaced the pre-existing flora and fauna.

Urban Ecosystem and Energy

Most urban ecosystems are heterotrophic.

In heterotrophic ecosystems, energy is introduced in the form of chemical compounds. These chemicals have been produced in other autotrophic ecosystems and have been transferred.

In urban ecosystems, the energy consumed by the inhabitants is often transferred from quite a distance.



Factors that shape the biocommunities of an urban ecosystem

The only truly successful urban organisms are humans, and animals that have been deliberately domesticated such as:

- horse,
- dog,
- cat,
- some bird species,

… and animals that have become unwanted companions such as:

- pigeons,
- mice,
- rats,
- cockroaches,
- some squirrels,
- and some other species of birds and animals.

The abiotic environment of a city is likely to be harsher than that of the open countryside, and few organisms adapt to live there.

Although this constant threat of changes in the urban environment poses a serious challenge to wildlife, there is no shortage of species that are able to adapt and take advantage of these specialized habitats (eg roofs and walls of buildings).), which provide niches available to be colonized by pioneering plants and animals.

The flora of a city is usually the result of human choices that often come into conflict with those defined by the climate of an area. Thus, we see cities in different longitudes and latitudes hosting the same plants species.

The selection of alien species creates problems as:

1. These have no natural enemies and thus they multiply uncontrollably.

2. Natural resources and mainly water are wasted for their maintenance.

Evolution of an urban ecosystem - Ecological succession?

- The urban ecosystem operates on the same principles as any other ecosystem.
- Its main feature is its constant exposure to drastic and rapid changes caused by e.g. from the demolition of buildings and the development of new building installations, new roads and roads, there is thus a rapid "succession".
- Humans consume huge amounts of energy to maintain an urban ecosystem, which seems to be in a state of disrepair.
- With energy consumption human prolongs an apparent balance in cities.
- But until when?
- Is such an approach sustainable and sustainable?

Interactions between the elements of an urban ecosystem

In urban ecosystems one can distinguish complex - sometimes unpredictable - interactions between elements. Some elements of urban ecosystems are:

- Water cycle and extreme phenomena such as floods and droughts (consider sidewalks, runoff…).
- Nutrient cycles such as nitrogen and phosphorus (consider fertilizers, dog and other animal feces, etc.).
- Flow of energy through natural and human networks (think of biomass from pruning, autumn leaves, car fuel, etc.).
- Geographical and climatic conditions.

Methods of studying the urban ecosystem

The urban ecosystem can be studied in 4 different ways:

1. Considering it as a "imaginary" organism. The transfer of energy, matter, people and information - knowledge within it, and the outputs and inputs, are the focus of this approach.

2. Studying the effects of the urban environment on terrestrial and aquatic ecosystems. The focus here is on the behaviors and reactions of all flora and fauna in urban conditions compared to those in natural environmental conditions.

3. Studying the effects of human-residential settlement on the abiotic environment.

4. Creating a model of the urban ecosystem, with networks of actions and reactions of the various components, to be used in ecosystem management, design and government and international decision making.

The basic principles of the science of Urban Ecology

1. Cities are ecosystems. Cities and urban areas are human ecosystems in which socio-economic and ecological processes are interdependent

2. Cities are spatially heterogeneous. Urban areas contain scattered areas of vegetation or streams that have remained or have been created recently and present ecological functions.

3. Cities are dynamic. Urban flora and fauna are diverse and this diversity has multiple dimensions (eg classification, phylogeny, function, geographical origin).

5. Cities connect human and natural processes. Human values and perceptions are a key link in the interactions between social and ecological components in urban ecosystems.

6. Ecological processes continue to operate in cities. Ecological processes are distributed differently in urban areas and service constraints and excessive risks are often associated with areas where human communities are poor, discriminated against or otherwise weakened.

7. The form of cities is heterogeneous on many levels, and this heterogeneity is particularly noticeable in cities and older suburbs.

8. The shape of cities reflects planning, but also random and indirect effects of social and environmental decisions.

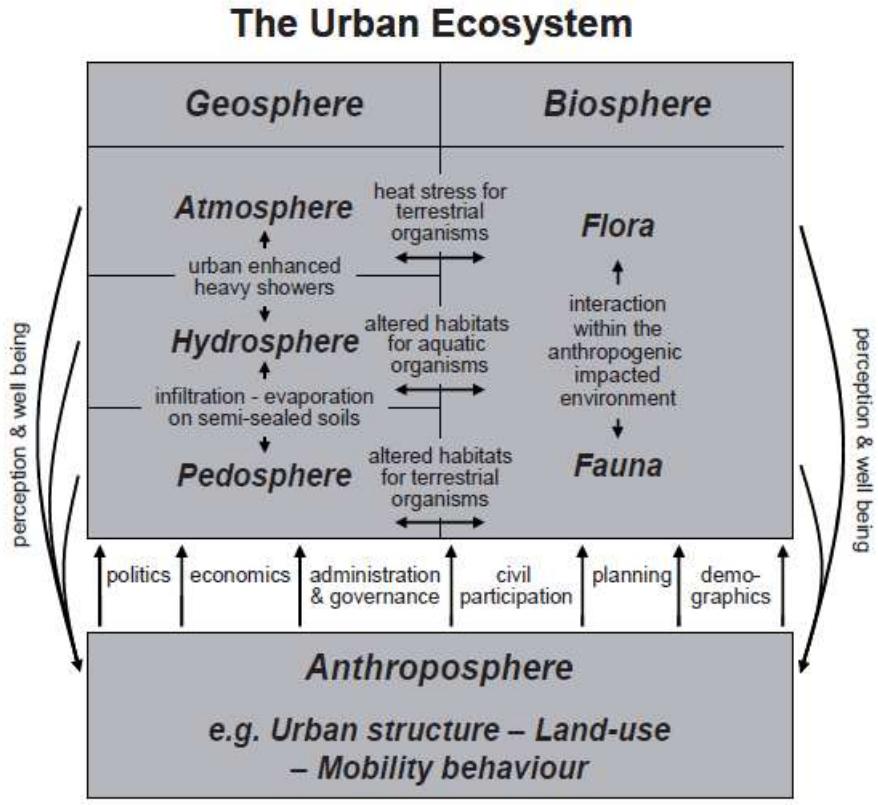
9. The form of cities is a dynamic phenomenon and presents temporal and local contradictions, which express different cultural and economic conditions of urbanization.

10. Urban plans and development projects at various scales can be considered as experiments and used to demonstrate the ecological implications of different design and management strategies

11. The definition of the boundaries and content of an urban system model is determined by researchers based on their research questions or spatial scope.

12. Urban cover and land uses are extended and separated by agricultural or wild lands and uses

13. Water flow, including clean water supply, waste and rainwater management, is a concern for urban and urbanized ecosystems around the world. Water connects cities with wider areas.



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