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of the European Union

Sustainable Natural Resource Use in Arctic and High Mountainous Areas

(SUNRAISE summer school - 2019)

Teaching materials

(Extract of some of the materials used)

ADAM MICKIEWICZ UNIVERSITY IN POZNAŃ

Urban Ecosystem Services in EU Perspective

Andrzej Mizgajski

6th SURE – Summer School,
Salzburg, July.2019

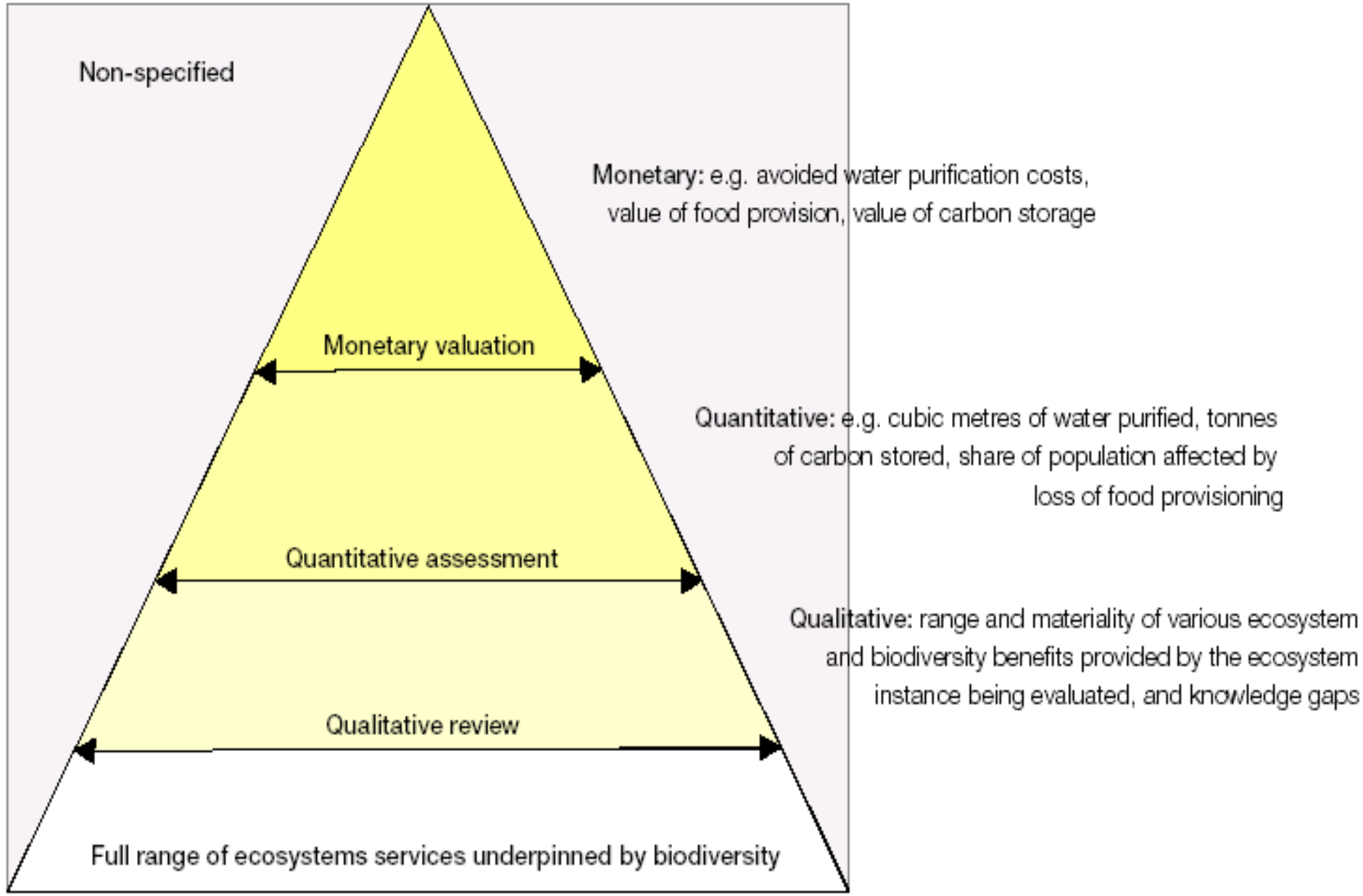
Objectives

- Why ecosystem services instead of nature conservation;
- The notion of Ecosystem Services – what is this;
- What European Institutions do for setting this approach in UE and Member States
- Urban Ecosystem Services – How EU deal withs this issue;
- Main groups of Ecosystem Services in urban areas;

The core elements of the Ecosystem Services Approach

- Ecosystem Services assessment based on the recognition of **natural processes as benefits** for Humans.
- Ecosystem services are percived as **health, ecological, economic and cultural values**, which result from natural processes (ecosystems).

Figure 3.2: Valuing ecosystem services

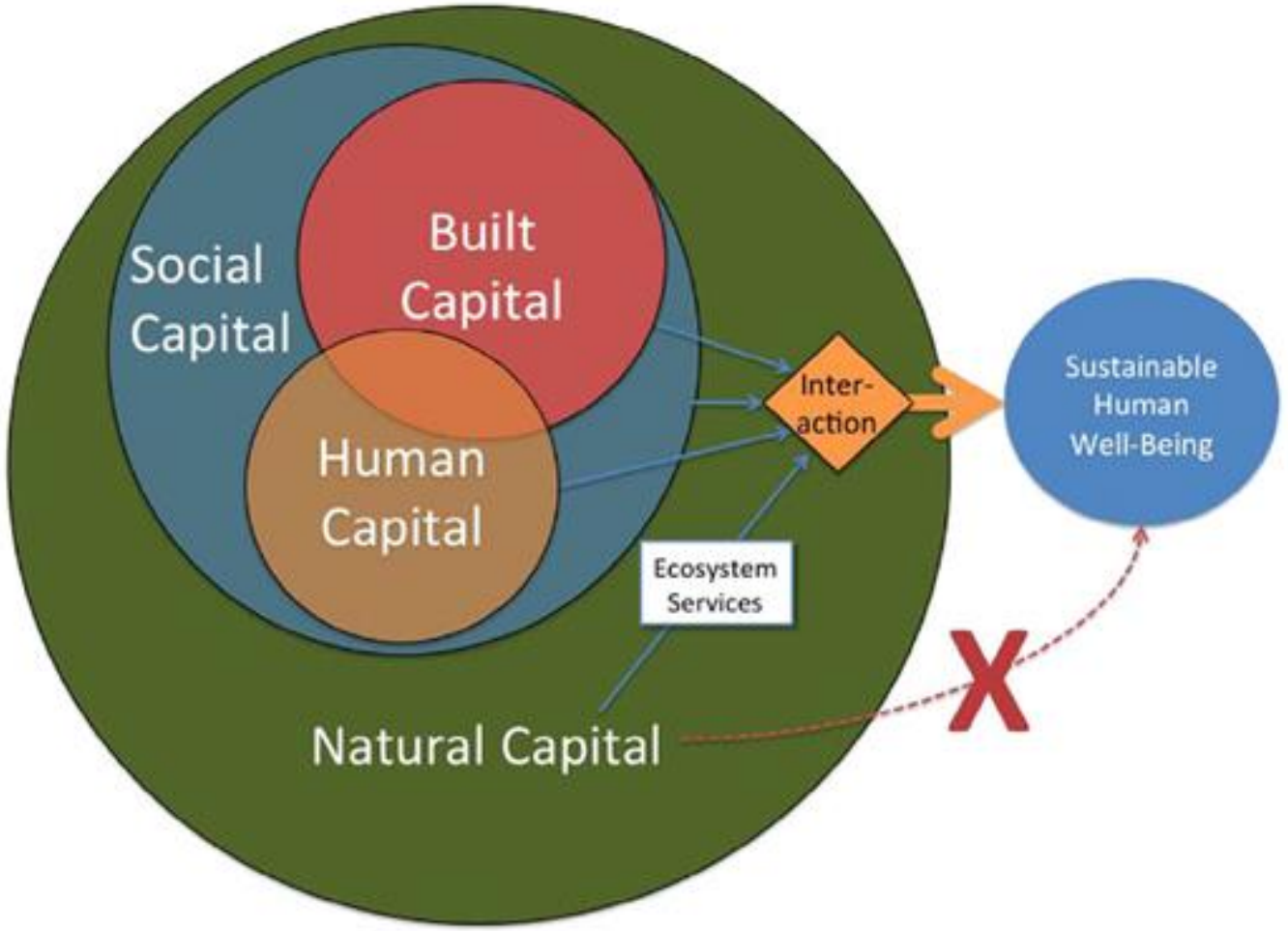


Source: P. ten Brink, Workshop on the Economics of the Global Loss of Biological Diversity, 5-6 March 2008, Brussels

The interaction between built, social, human and natural capital affects human wellbeing

(Costanza et al., 2014b)

Built capital and human capital (the economy) are embedded in society, which is embedded in the rest of nature.
Ecosystem services are the relative contribution of natural capital to human wellbeing, they do not flow directly. It is therefore **essential to adopt a broad, transdisciplinary perspective** in order to address ecosystem services).



Urban Ecosystem Services and Biodiversity among EU activities

- Target 2, Action 5, of the EU Biodiversity Strategy to 2020 - Member States, with the assistance of the Commission, will map and assess the state of ecosystems and their services in their national territory by 2014, assess the economic value of such services, and promote the integration of these values into accounting and reporting systems at EU and national level by 2020;
- Action 5 is implemented by the MAES (Mapping and Assessment of Ecosystems and their Services) Working Group affiliated at the European Commission;
- EC Strategic document, 2013 - Green Infrastructure (GI) — Enhancing Europe's Natural Capital.

Green Infrastructure – according to EC Document ({SWD(2013) 155 final}

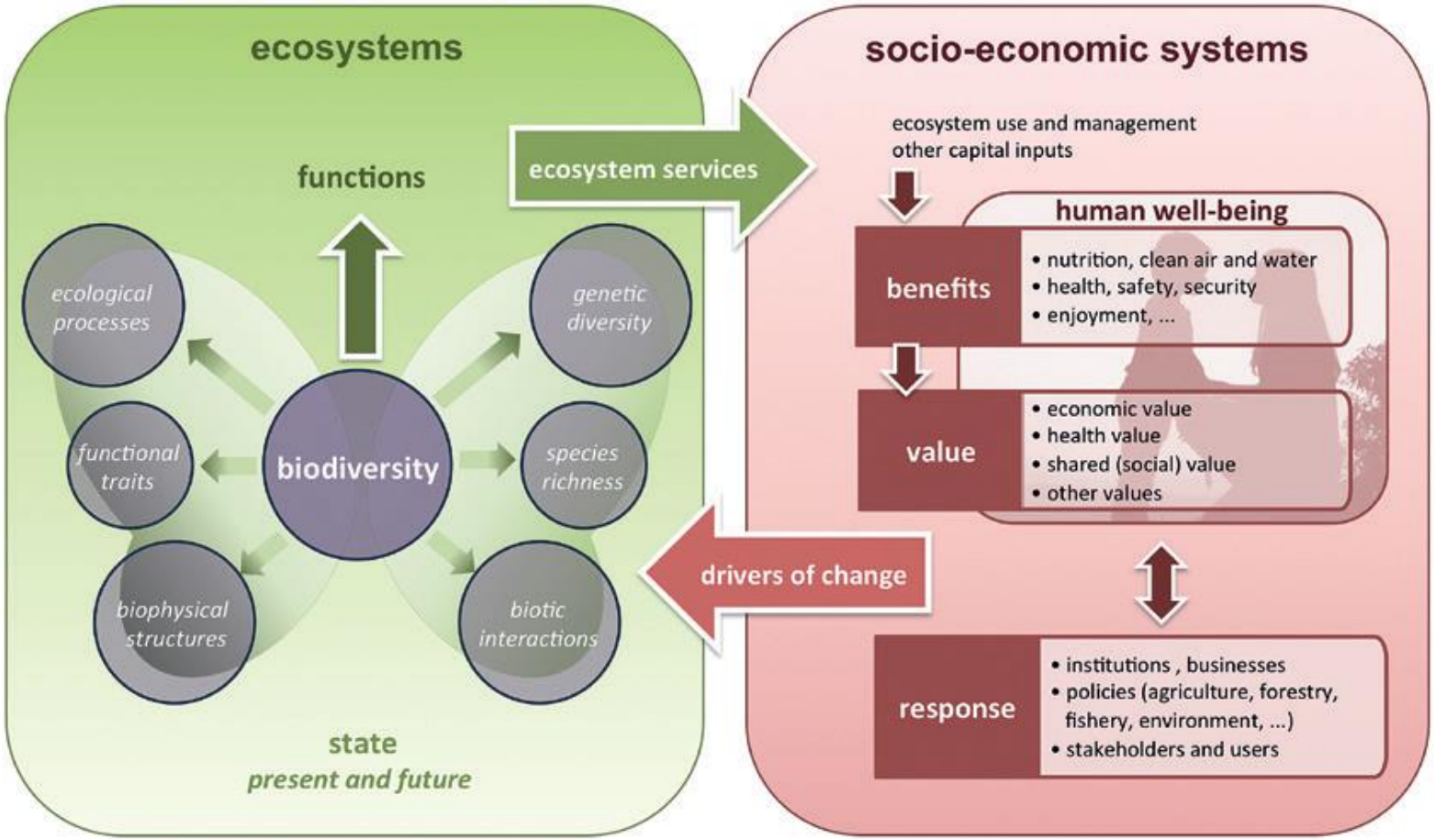
The state of issue:

- the built infrastructure (grey infrastructure) — is seen as a substitute for natural solutions to problems such as flood prevention.
- In Europe we consequently continue to degrade our natural capital, jeopardising our long-term sustainability and undermining our resilience to environmental shocks.

Green Infrastructure definition:

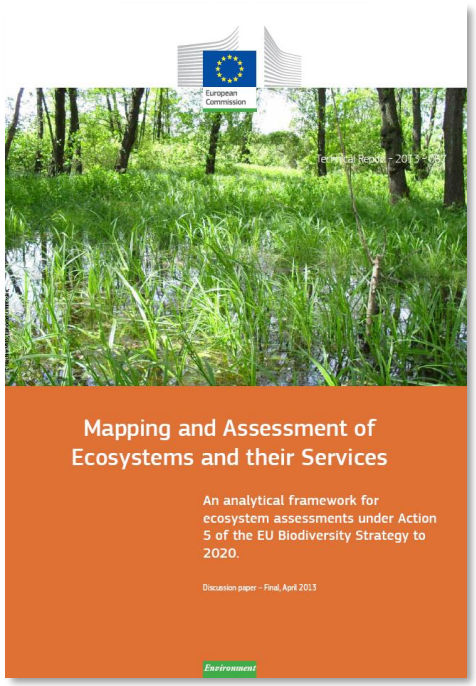
- *„A strategically planned network of natural and semi-natural areas with other environmental features designed and managed to deliver a wide range of ecosystem services. (…) On land, GI is present in rural and urban settings”*

The conceptual framework drawn up by the MAES initiative (Maes et al., 2013a)

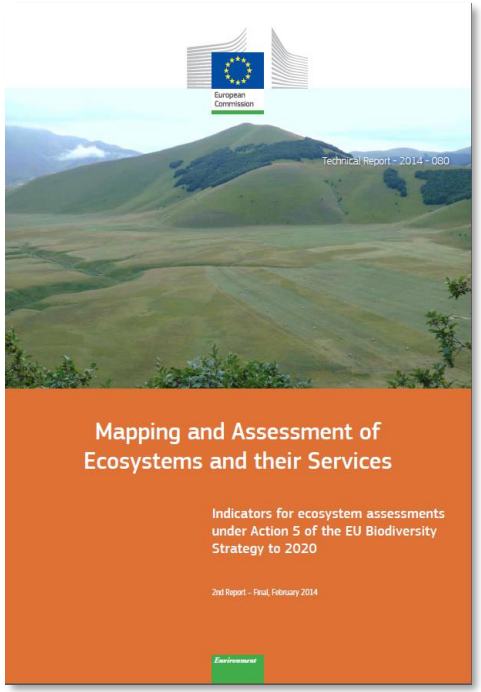


Technical reports of the MAES WG

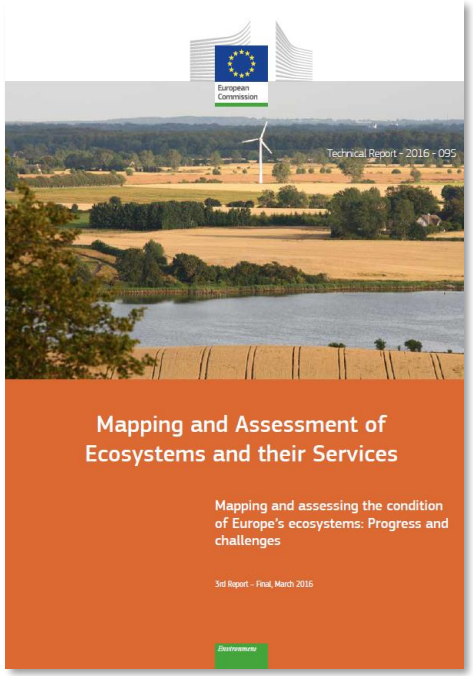
2013



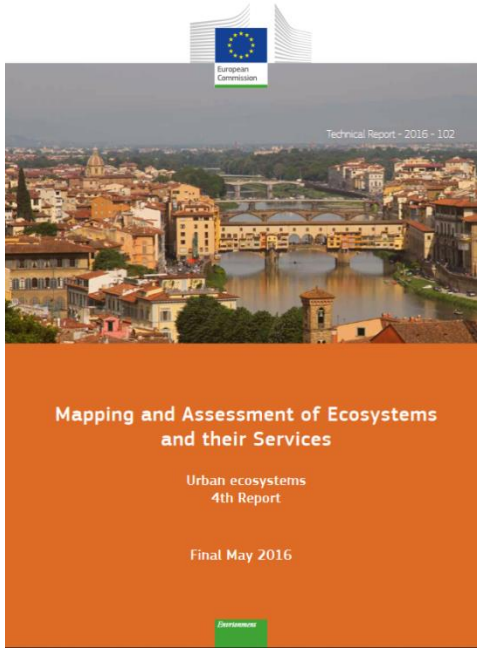
2014



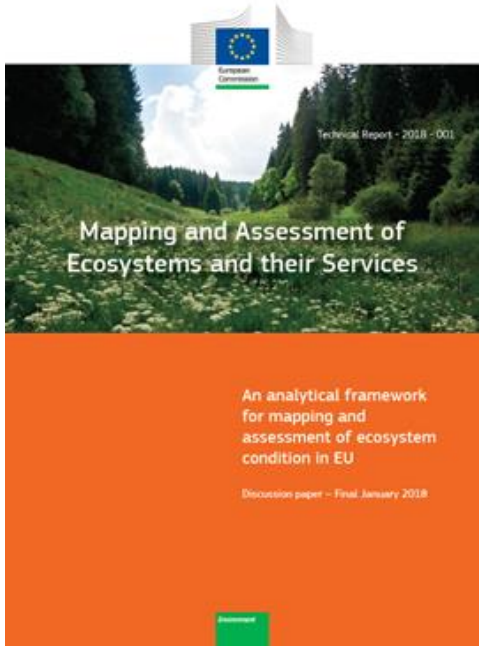
2016



2016



2018



http://ec.europa.eu/environment/nature/knowledge/ecosystem_assessment/pdf/MAESWorkingPaper2013.pdf

http://ec.europa.eu/environment/nature/knowledge/ecosystem_assessment/pdf/2ndMAESWorkingPaper.pdf

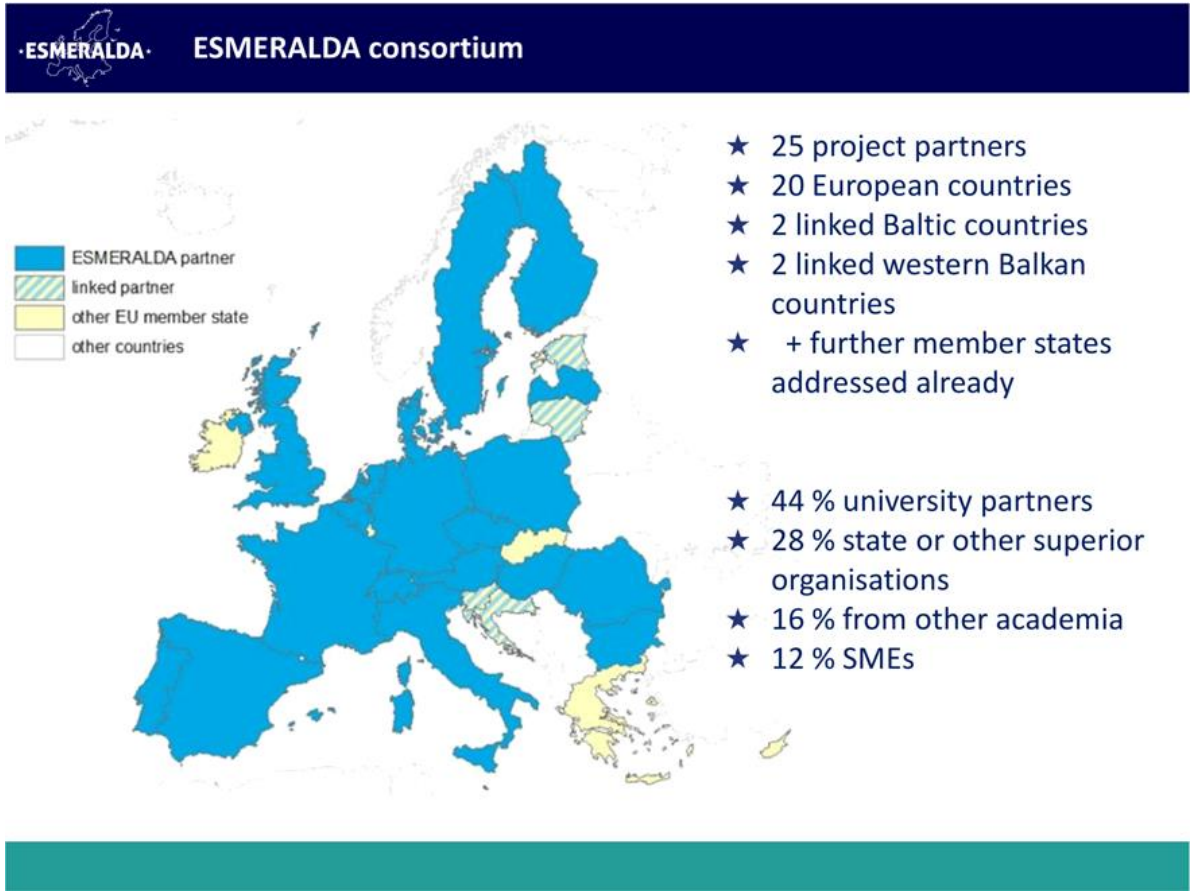
http://ec.europa.eu/environment/nature/knowledge/ecosystem_assessment/pdf/3rdMAESReport_Condition.pdf

http://ec.europa.eu/environment/nature/knowledge/ecosystem_assessment/pdf/102.pdf

http://ec.europa.eu/.../ecosystem_assessment/.../5th%20MAES%20report

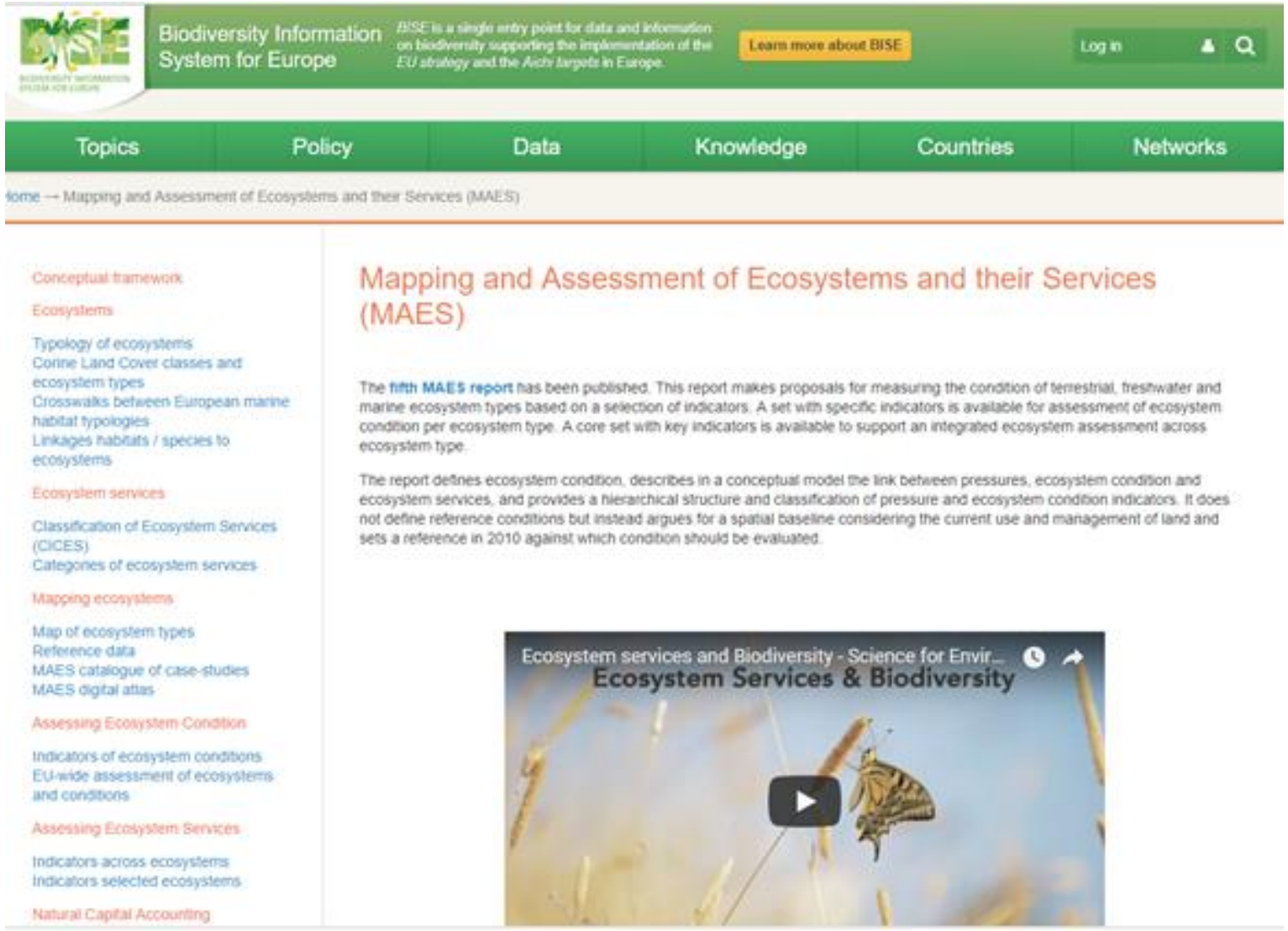
OPENNESS and **ESMERALDA** – EU Scientific-aplied Projects

Operationalisation of Natural Capital and Ecosystem Services



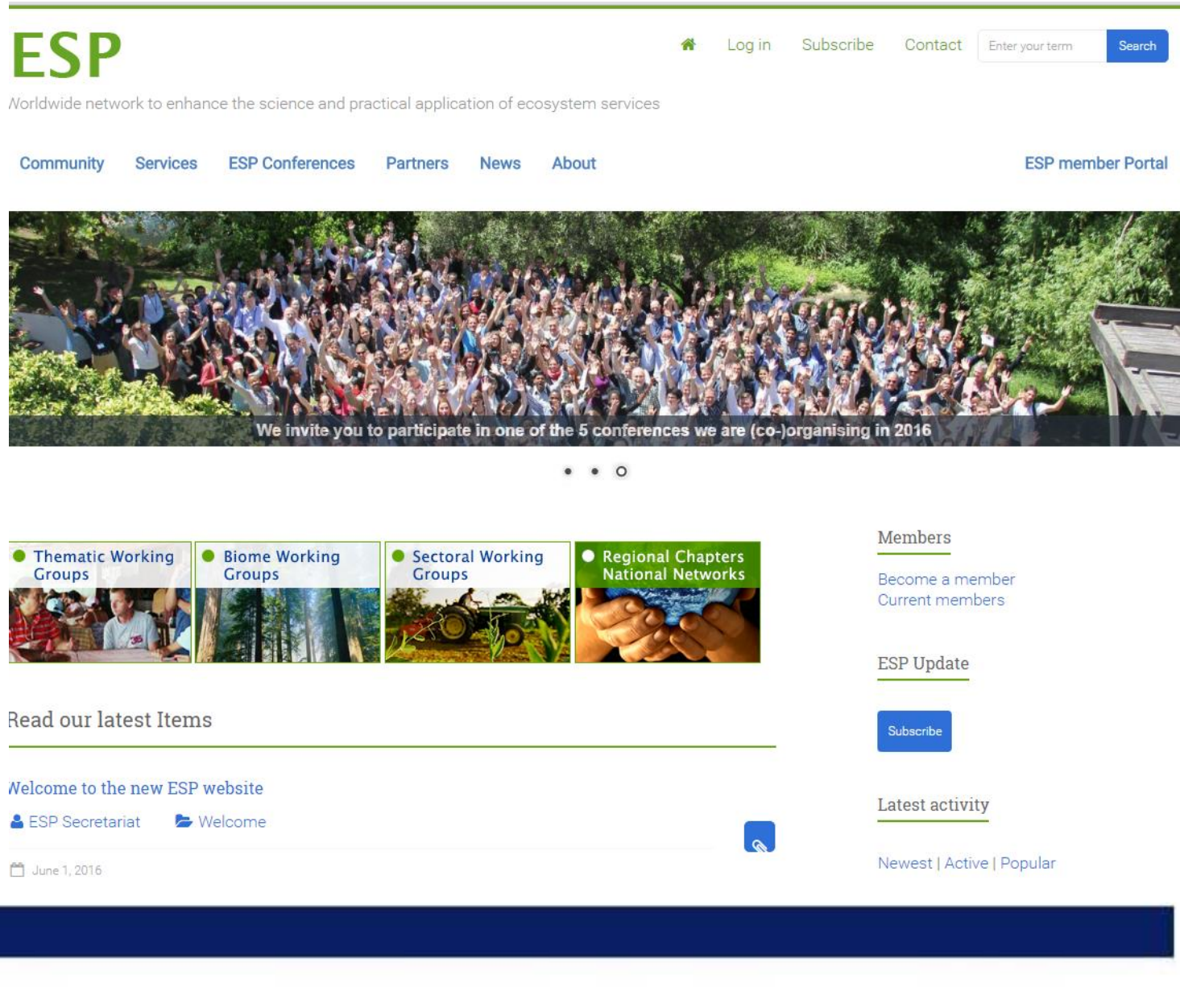
Enhancing Ecosystem Services Mapping for Policy and Decision Making

BISE – Biodiversity Information System for Europe

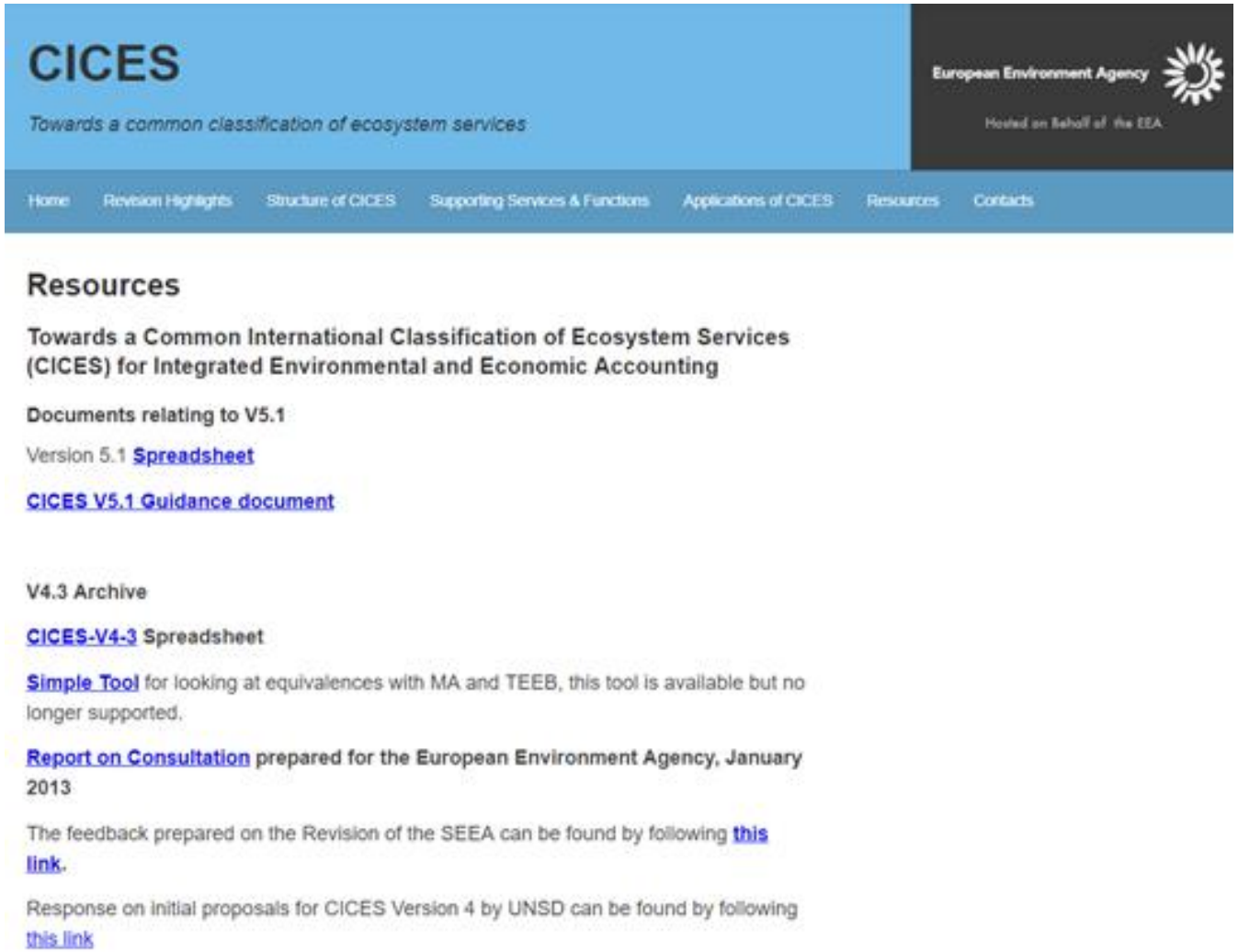


http://biodiversity.europa.eu/maes/

OPPLA – Platform and ESP – Ecosystem Services Partnership



Common Classification of Ecosystem Services



CICES

Towards a common classification of ecosystem services

European Environment Agency

Hosted on behalf of the EEA

Home | Revision Highlights | Structure of CICES | Supporting Services & Functions | Applications of CICES | Resources | Contacts

Resources

Towards a Common International Classification of Ecosystem Services (CICES) for Integrated Environmental and Economic Accounting

Documents relating to V5.1

Version 5.1 **Spreadsheet**

CICES V5.1 Guidance document

V4.3 Archive

CICES-V4-3 Spreadsheet

Simple Tool for looking at equivalences with MA and TEEB, this tool is available but no longer supported.

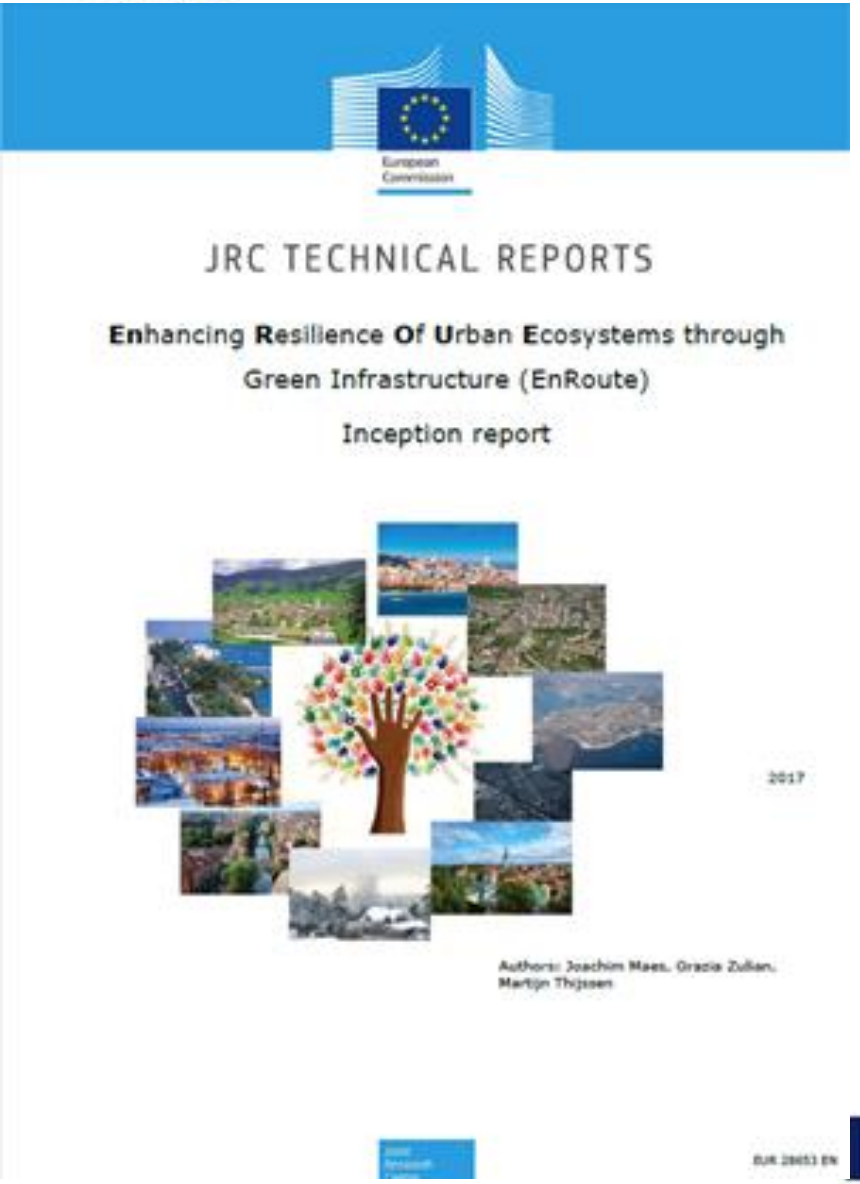
Report on Consultation prepared for the European Environment Agency, January 2013

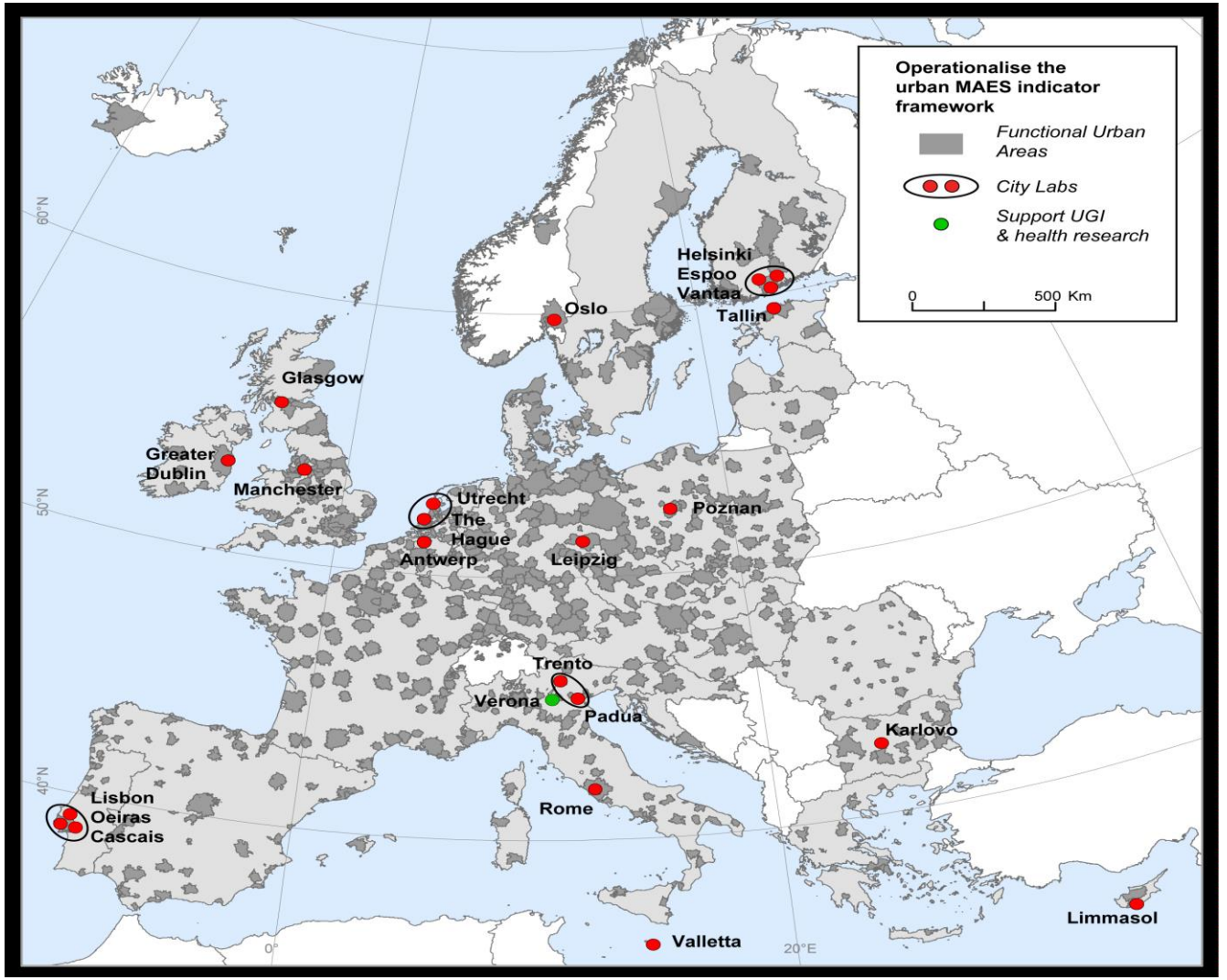
The feedback prepared on the Revision of the SEEA can be found by following **this link**.

Response on initial proposals for CICES Version 4 by UNSD can be found by following this link

https://cices.eu/resources/

EnRoute tests the MAES urban ecosystem assesment framework





Urban Ecosystem Services - PROVISIONING SERVICES

- **Food supply**

Urban Agriculture (UA) and community gardening potentially decrease the distance between production and consumption— “food miles”—, lowering fossil fuel use and transportation costs.

UA can strengthen a sense of community, reconnect consumers with farmers, raise awareness on the environment and human health

UA has the potential to create a more ecologically-sound, resilient, and productive landscape.

- **Water supply - drinking and non –drinking water**

Collected precipitation, abstracted surface and ground water from rivers, lakes and other open water bodies for drinking or domestic use, irrigation, livestock consumption, industrial use

Source: 6_Annex to 4th MAES Report

Urban Ecosystem Services - REGULATING SERVICES

Air quality regulation - Urban vegetation can improve the air quality by removing or intercepting pollutants. The capacity of urban trees and vegetation to intercept pollutants varies according to plant species, age and health status of the tree.

Noise mitigated by vegetation - Urban soil and plants can reduce noise pollution through absorption, deviation, reflection and refraction of sounds.

Water flow regulation - run off mitigation and flood protection - Vegetated areas contribute to prevent and mitigate negative effects in several ways by intercepting water or through percolation.

Pollination -Conserve, restore and promote the use of patches of natural and semi-natural habitats on farms, rural-urban fringes and residential neighborhoods, can support wild pollinators maintaining floral resources and nesting sites.

Global Climate regulation - Vehicle traffic, industry, energy used for public lighting and industrial, commercial and building consumption are the main source of emissions.

Urban temperature regulation - Urban blue and green infrastructure can contribute to the regulation of local temperatures. Water areas and large water bodies regulates the temperature. Vegetation and trees can help through: evapotranspiration, shading, reducing wind speed.

Source: 6_Annex to 4th MAES Report

Urban Ecosystem Services - CULTURAL SERVICES

Cultural ecosystem services are defined as material and non-material benefits that people obtain from the contact with nature.

Recreation – physical, social, spiritual and mental well-being

Nature exploration;

Nature contemplation;

Living in an attractive and healthy environment;

Nature education

Source: 6_Annex to 4th MAES Report

EEA Data bases relevant to UES (1)

Data	Description	Website
Urban Atlas 2006 and 2012	The Urban Atlas is providing pan-European comparable land use and land cover data for Functional Urban Areas (FUA). Urban Atlas 2006: FUAs with more than 100.000 inhabitants as defined by the Urban Audit. The GIS data can be downloaded together with a map for each urban area covered and a report with the metadata. Urban Atlas 2012: 695 UA 2012 FUAs including 301 existing UA2006 FUAs and 394 new FUAs .	http://land.copernicus.eu/local/urban-atlas/view
Corine Land Cover	Updates have been produced in 2000, 2006, and 2012. It consists of an inventory of land cover in 44 classes (available for 1990-2000-2006-2012). CLC uses a Minimum Mapping Unit (MMU) of 25 hectares (ha) for areal phenomena and a minimum width of 100 m for linear phenomena.	http://land.copernicus.eu/pan-european/corine-land-cover
High Resolution Layer (HRL) Imperviousness	The imperviousness HRL captures the spatial distribution of artificially sealed areas	http://land.copernicus.eu/pan-european/high-resolution-layers/imperviousness
Land uptake	Land take by the expansion of residential areas and construction sites	http://www.eea.europa.eu/data-and-maps/indicators/land-take-2/assessment-2

EEA Data bases relevant to UES (2)

CORILIS	The purpose of CORILIS is to calculate "intensities" or "potentials" of a given theme in each point of a territory. CORILIS results into probability surfaces (varying from 0 to 100) for the presence of a certain Corine land cover (CLC) class within a defined smoothing radius (here: 5 km).	http://www.eea.europa.eu/data-and-maps/data/corilis-2000-2#tab-gis-data
EEA Airbase (Concentration of air pollutants)	AirBase is the public air quality database system of the EEA. It contains air quality monitoring data and information submitted by the participating countries throughout Europe.	http://www.eea.europa.eu/themes/air/air-quality/map/airbase
National Designated Areas	If agreement on the definition on "protected natural areas" as used for the European inventory of nationally designated areas which holds information about protected areas and the national legislative instruments, which directly or indirectly create protected areas.	http://www.eea.europa.eu/data-and-maps/data/nationally-designated-areas-national-cdda-8
Natura 2000	Natura 2000 (an EU-wide network of nature protection areas established	http://ec.europa.eu/environment/nature/natura2000/access_data/index_en.htm

EEA Data base relevant to UES (3)

	under the 1992 Habitats Directive) is the centerpiece of EU nature & biodiversity policy. The aim of the network is to assure the long-term survival of Europe's most valuable and threatened species and habitats.	
	A selection of N2K grassland-rich sites (5 grassland habitats types 6210, 6240, 6250, 6510 and 6520, including a 2km buffer and covering approx. 160.000 km2) sites was mapped in order to assess their actual area, their condition and their development over time. The sites were analysed for the 2006 and 2012 reference years and a change analysis was performed. The mapping also included a 2km buffer zone where an analysis of pressures and threats was conducted. The analysis focused on a selection of grassland (semi-natural/species rich) habitat types.	http://land.copernicus.eu/local/natura/view
Riparian zones	Riparian zones represent transitional areas occurring between land and freshwater ecosystems, characterized by distinctive hydrology, soil and biotic conditions and strongly influenced by the stream water. They provide a wide range of riparian functions (e.g. chemical filtration, flood control, bank stabilization, aquatic life and riparian wildlife support, etc.) and ecosystem services.	http://land.copernicus.eu/local/riparian-zones/view

Andrzej Mizgajski, PhD, Prof.
Adam Mickiewicz University in Poznań
Faculty of Geographical&Geological Sciences
Department of Integrated Geography, Head
ul. Bogumila Krygowskiego 10, 61-680 Poznań, Poland
tel. +48 61 829 6229
andrzej.mizgajski@amu.edu.pl

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Alexander EVDOKIMOV,
Russian State Hydrometeorological University,
St. Petersburg, Russia

The sustainable development of Mining in Arctic mountain regions

SUNRAISE – SURE Summer School

URBAN + MOUNTAINS

7th – 14th of July 2019

Salzburg, Austria

In the name of the report the discrepancy of sustainable development and mining production is easily read. One excludes another.

But it is real need of coexistence of exhaustible resources and their replacement by inexhaustible resources and need of preservation of both resources for future generations of people.

Not many examples of really sustainable environmental management can be found in the Arctic mountains.

One of them - Kislogubsky PES (tidal electrostation)— the experimental tidal power plant located in a fiord Kislaja the Barents Sea near the settlement of Murmansk region, Kola Peninsula

It is the first and single tidal power plant of Russia. Stays on the state registry as a monument of science and technology. Power of the station — 1.7 MW (originally 0.4 MW).The station is established in a narrow part of the bay Kislaja, height of inflows in which reaches 5 meters.

Another one is Mutnovskaya GEOES — the largest geothermal power plant of Russia. It is located in Elizovsky district of Kamchatka region, to the northeast from Mutnovskaya of the hill, at the height about 800 meters above sea level. The station is operated by JSC Geoterm (enters into the RusHydro group)

Mutnovskaya GEOES represents geothermal power plant with direct use of steam. Rated capacity of power plant — 50 MW. The geothermal heat carrier (steam-and-water mix) enters on the station on pipelines from the wells (as of 2017, is operated 12 wells) drilled on the Mutnovsky field.

View of Mutnovskaya GEOES, well receivers and environmental mountains

Mutnovskaya GEOES functions as a part of the central power unit of the Kamchatka power supply system working separately from UES of Russia. The power unit is created in the southern part of Kamchatka Region where the main part of the population lives. Synchronously the Upper Mutnovsky geothermal power plant, the Kamchatka CHPP-1 and CHPP-2, hydroelectric power stations of a cascade of Tolmachyovsky hydroelectric power stations works with Mutnovska GEOES. Development by Mutnovska GEOES makes about 350 million kWh a year and covers 20% of electricity consumption in the Central power unit of Kamchatka Krai, a capacity factor of rated capacity — 78.5% [1].

The majority of mines and fields of hydrocarbons are exhaustible, and it is necessary aspires that development of minerals in the Arctic didn't carry are significant damage to the nature.

The joint-stock company Olenegorsky Mining and Processing Integrated Works (JSC Olcon) develops the fields of ferruterous quartzites of the Zaimandrovsky iron ore area located on the Kola Peninsula (The Murmansk Region) in the neighborhood of Olenegorsk. These fields are one of raw material resources of the world's largest steel and mining company PJSC Severstal including the divisions "Severstal Russian Steel", and "Severstal the Resource". JSC Olcon is included into a mining division — one of the largest producers of an iron ore concentrate, pellets, the coked coal in Russia today.

Olenegorsky GOK makes a high-quality iron ore concentrate with iron content over 67%. The main consumer of an iron ore concentrate is the Cherepovets iron and steel works PJSC Severstal. In 2010 Olenegorsky GOK delivered to consumers 4.2 million tons of an iron ore concentrate. In the 2011th - 4.6 million tons, in the 2015th, 2016th and 2017th - on 4.1 million tons.

Map of the Kola Peninsula. Russia

Seid Lake

Khibiny Mountains

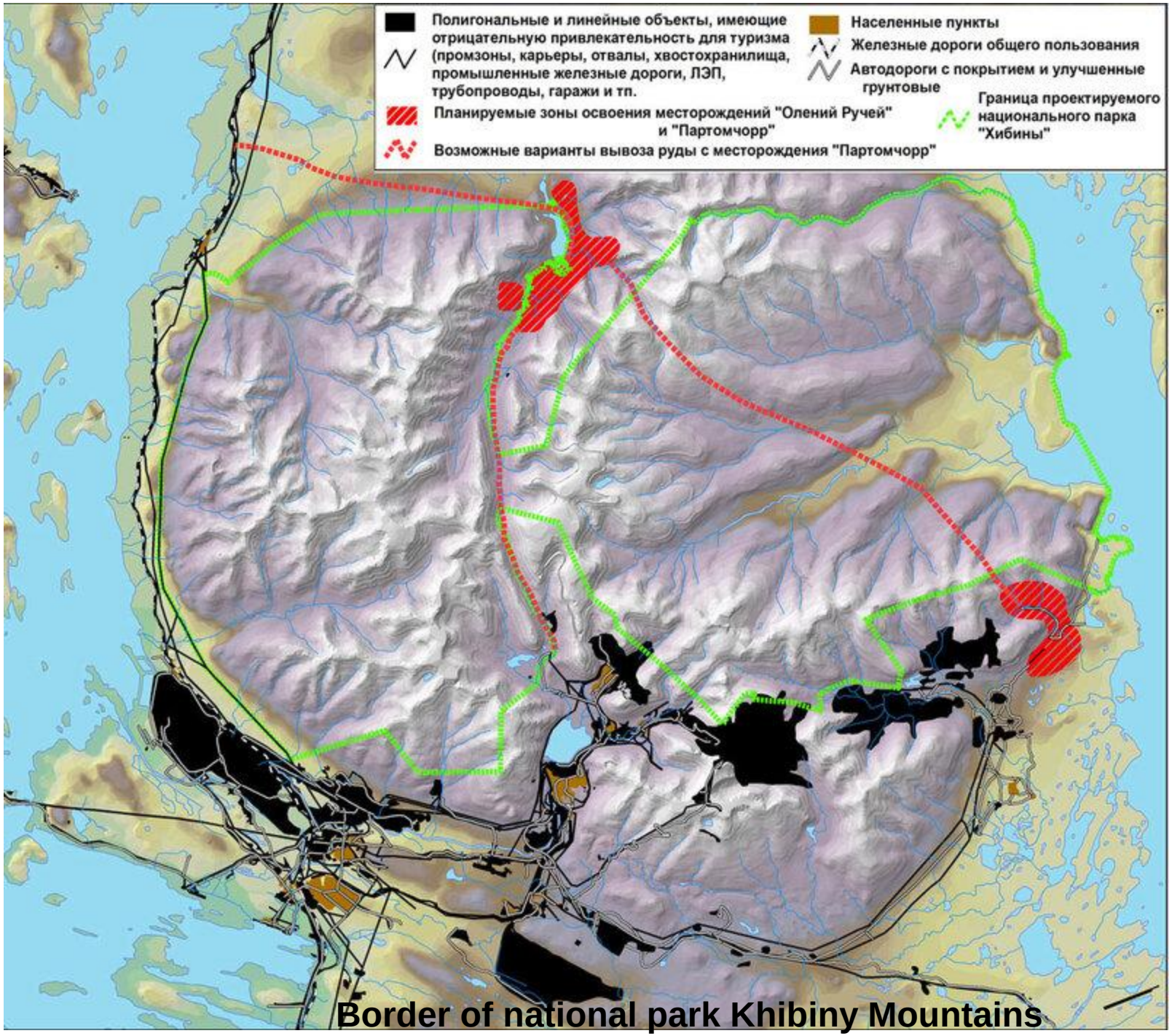
Khibiny Mountains

Enterance in Mo mining adit in Khibiny Mountains

Khibiny Mountains in winter

View of the Rasvumchor mine (Khibiny Mountains, Cola Peninsula)

The first sun in Khibiny Mountains



Border of national park Khibiny Mountains

Across Khibiny Mountains on ATVs

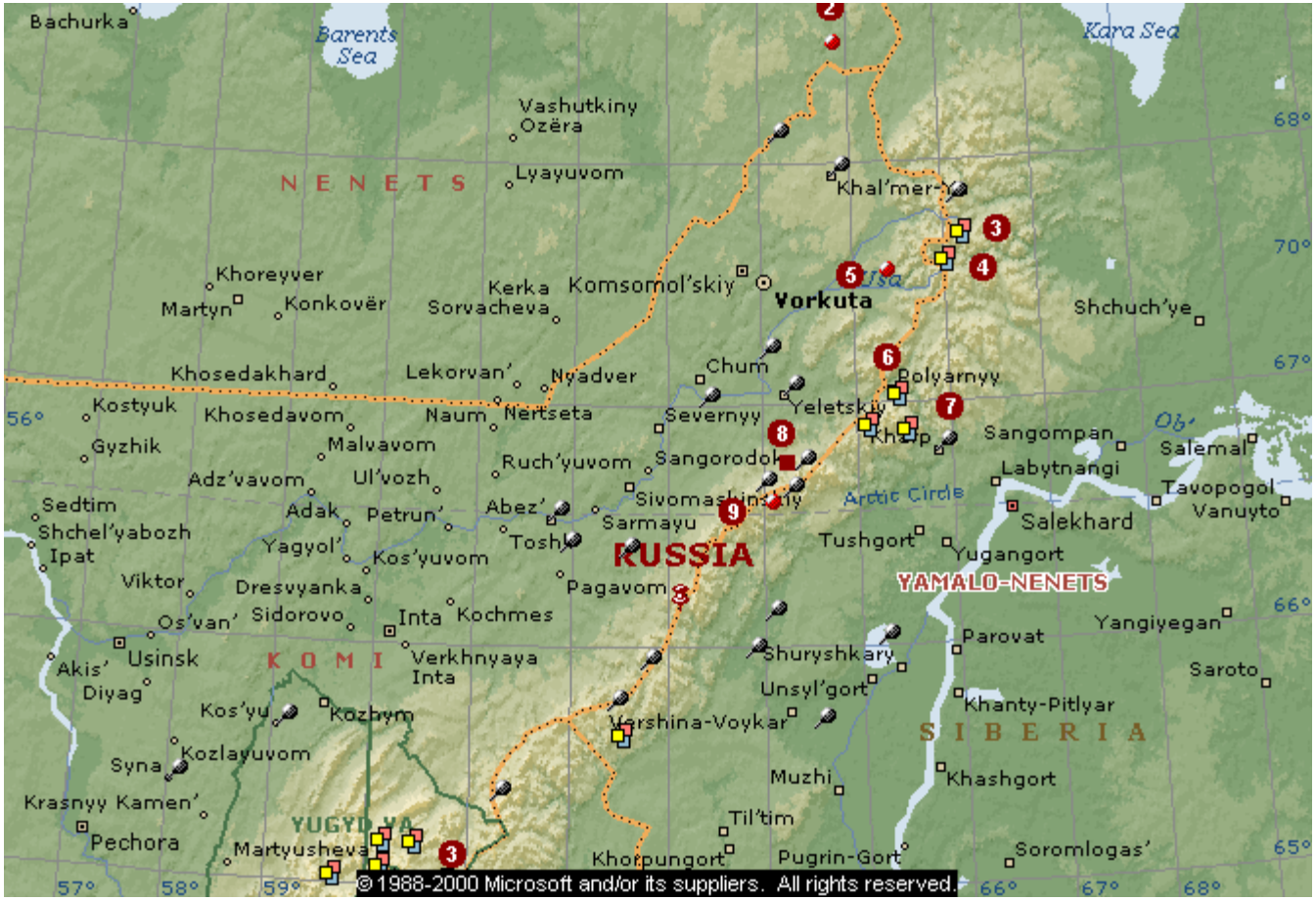
The ore chute in the Hibinsky field

Even the excavator froze

The city of Kirovsk in Khibiny Mountains

The restroom in the depth of the underground mine

Rhinestone (druse), Perekatnoye Aldan field


Bachurka
Barents Sea
Kara Sea
Vashutkiny
Ozëra
NENETS
Lyayuvom
Khal'mer-Yu
Khoreyver
Martyn
Konkovër
Kerka
Sorvacheva
Komsomol'skiy
Vorkuta
Shchuch'ye
Khosedakhard
Lekorvan'
Nyadver
Chum
Polyarnyy
Kostyuk
Khosedavom
Naum
Nertseta
Severnyy
Yeletskiy
Gyzhik
Malvavom
Sangompan
Ob'
Salemal
Adz'vavom
Ul'vozh
Ruch'yuvom
Sangorodok
Labytnangi
Sedtim
Adak
Petrun'
Abez'
Sivomaskinskiy
Arctic Circle
Tavopogol
Vanuyto
Shchel'yabozh
Sarmayu
Salekhard
Ipat
Yagyol'
Kos'yuvom
Toshka
RUSSIA
Tushgort
Yugangort
Viktor
Dresvyanka
Pagavom
YAMALO-NENETS
Os'van'
Sidorovo
Inta
Kochmes
Yangiyegan
Parovat
Akis'
Usinsk
KOMI
Verkhnyaya Inta
Shuryshkary
Saroto
Diyag
Unsyl'gort
Kos'yu
Kozhym
Vershina-Voykar
Khanty-Pitlyar
SIBERIA
Kozlayuvom
Syna
Muzhi
Khashgort
Krasnyy Kamen'
Til'tim
Pechora
Martyushevo
Khorpungort
Pugrin-Gort
Soromlogas'
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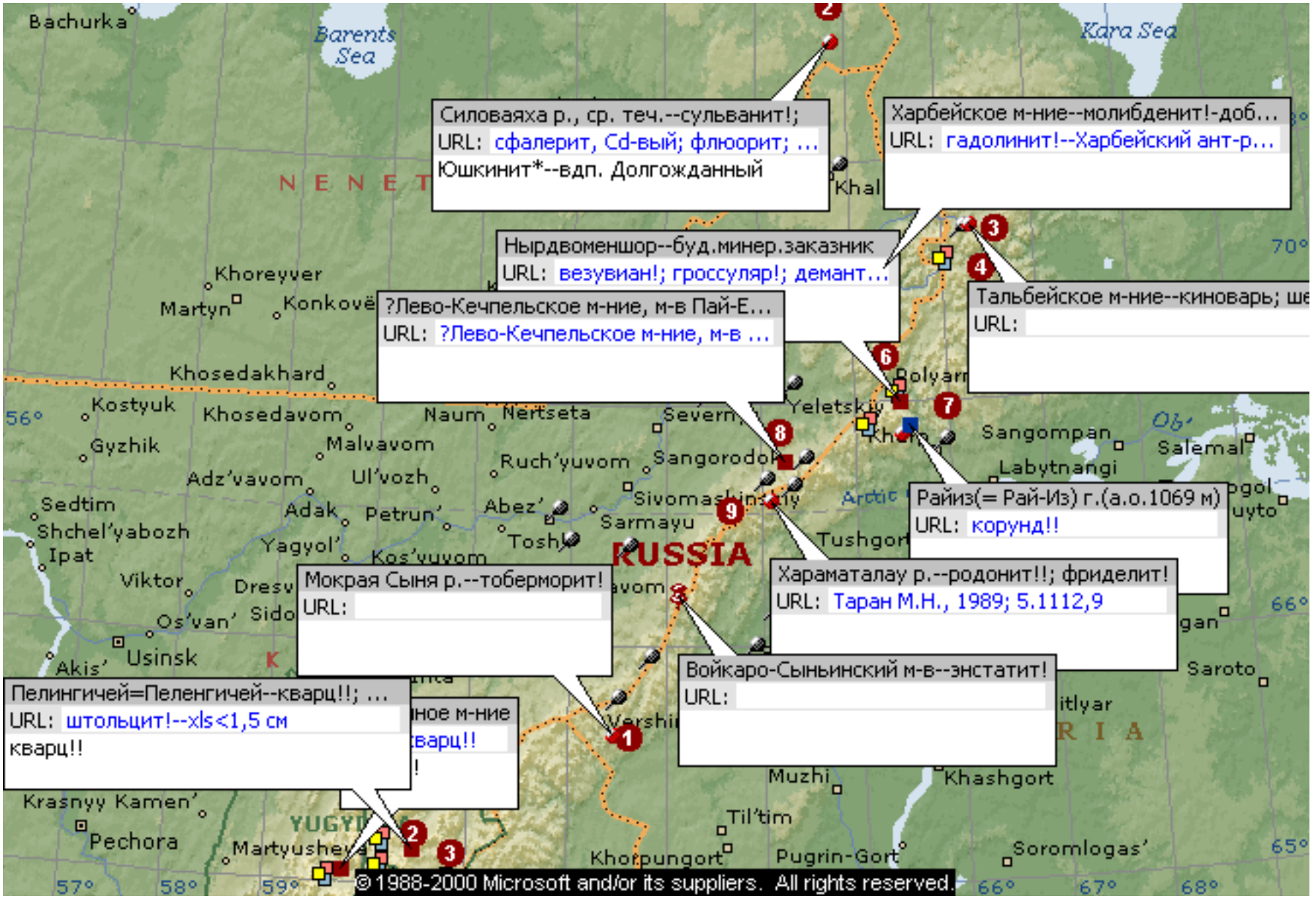


Locations of minerals of Polar Ural Mountains and adjacent territories with examples of finds. Made: © A.A. Evseev.

Gold mining in the Subpolar Urals began decades ago and led to environmental problems in this territory.
Development of gold always negatively influences in the open way the nature and destroys a local ecosystem.
The fertile layer covering from above places of deposits of metal is completely destroyed.
Thousands of tons of a soil from estimated location of gold pour bulldozers, excavators,
pass through flushing systems.
Under pressure the strong water jet precious metal is purified from soil impurity, accumulates in the closed trenches.
Process is called "to wash gold".
The streams, muddy and poisonous for fishes, which are formed as a result of washing of a soil are delivered with waters of the rivers on hundreds of kilometers.

Pollution continues decades after completion of works on the mines as dumps continue to be washed away.
Negative impact on the nature — an integral part of process of production, it is considered norm and expenses, for it compensation for estimated damage is raised from developers. Such picture everywhere,
where there is a gold mining, and the rivers of the Subpolar Urals, unfortunately, not an exception.
The trouble is that here, in the Subpolar Urals, the rivers spawning.

The bottom sediment of the river is visible even in the winter. Though through hundred kilometers dregs are already imperceptible and high layers of water are transparent,
however it is worth falling more deeply, and you will see how millions of particles of a suspension shining on light make water non-transparent.
Fishes react to this suspension.
Many years fish doesn't come into Manyyu on spawning, and once the river was considered as the most spawning in the Subpolar Urals.
The fact is that the river as a spawning area died.

Enzorit. [Enzorjyakh of river], Polar Ural Mountains, Russia. 40 mm. Photo: © N.A. Koltova

It is necessary to find an opportunity to statut impose a tough ban and to stop production of loose precious metals in the Subpolar Urals, then, possibly, in many years fish will return to these rivers. However, it is trusted hardly. Who will be engaged in it?.

Mn-Fe field, Komi Republic (western slope of the Subpolar Urals), Urals Subpolar, Russia

The field is located on the western slope of the Subpolar Urals in 70 km to the east from the city of Inta, on average a current of the river Parnok-Yu (east inflow of the Lemva River).

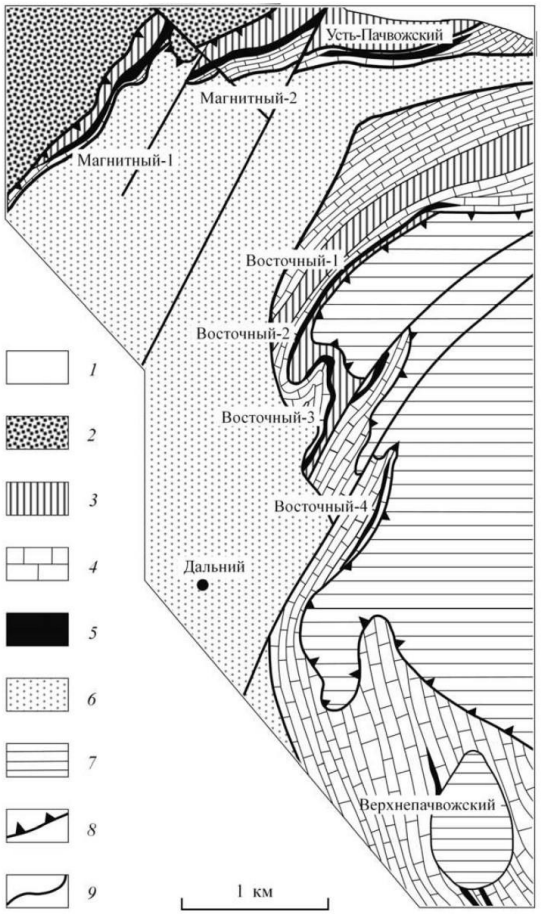
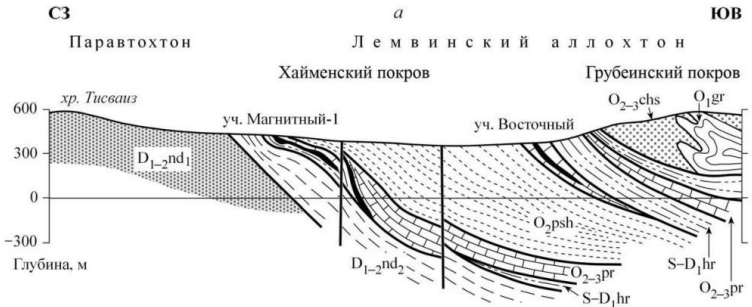


Рис. 4. Схема геологического строения района Парнокского месторождения (по М. А. Шишкину и Н. Н. Герасимову (1995) с упрощениями)

1 – четвертичные пески, супеси, глины, галечник; *2* – кварцевые песчаники и алевролиты; *3* – углеродистые глинисто-кремнистые сланцы (харотская свита); *4* – известняки и углеродистые глинисто-кремнисто-известковистые сланцы (парнокская толща); *5* – рудные залежи; *6* – известковистые песчаники; *7* – пестроцветные гематитсодержащие кремнисто-глинистые сланцы; *8* – главные надвиги; *9* – другие разломы.



Manganese carbonaceous ores of brown and cream color are primary; they consist generally of rhodochrosite, the manganokaltsit, rhodonite. The average content of manganese in them is 24%. On the top horizons of the field, up to the depth of 30-70 m, carbonaceous ores are transformed to the black oxidized ores consisting of a psilomelan, the gausmannit, pyrolusite, etc. In 1993 on the Parnoksky field the pit began experienced extraction of the oxidized manganese ores.

We have to develop methodology of sustainable land use in the Arctic mountains on the basis of maintaining of necessary level of a biotic regulation of a surrounding medium, hierarchy of levels of management of sustainable land use (conceptual, ideological, political and economic) and the scientific and technological principles of sustainable land use in the industrial regions.

The principles include justification of strategic priorities and indicators of sustainable land use in the industrial regions; complex (ekologo-economic) assessment of land resources taking into account features of the industrial productions; definition of "corridors" of admissible land use in the industrial regions;

coordination of individual interests of land users with public preferences;

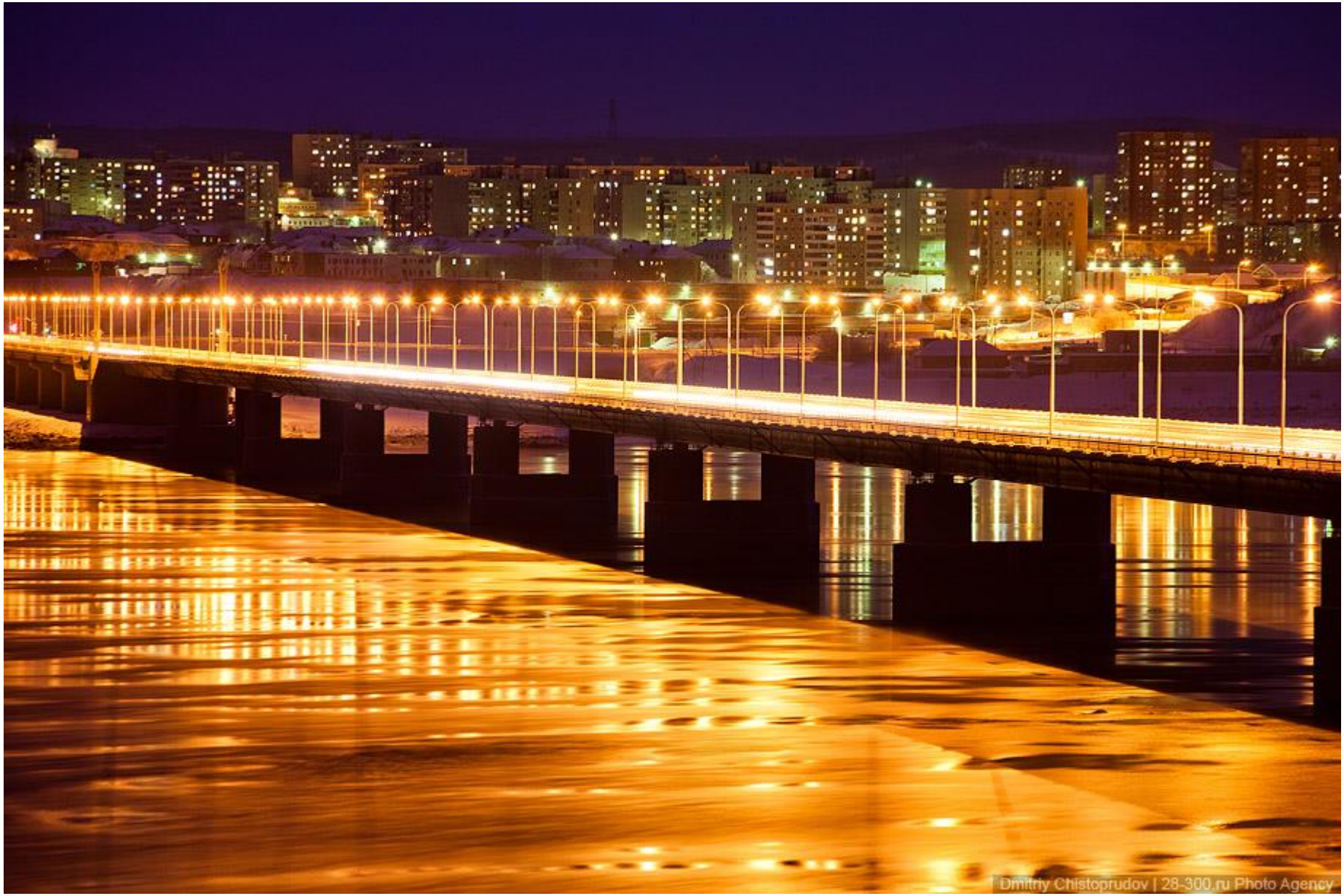
a multicriteria optimization of land use on the basis of ekologo-economic and social indicators.

The considered cross-disciplinary approach with use of rigorous mathematical formalization social sustainable - economic processes in the sphere of land use will allow to consider the modern calls, to reduce scratches and to soften consequences of negative situations.

The fundamental scientific base of methodology of a complete solution of ekologo-economic and social problems of mountain Arctic use is based on knowledge in the field of Arctic ecology, mountain biology, mountain geology, economy, sociology, technical science.

Murmansk – the biggest on population the northern city of Russia located behind a polar circle. Number is it nearly 300 thousand people. Murmansk which stretched more than for 150 sq.m. is on the edge of the Kola Peninsula on east coast of Kola Bay of the Barents Sea. East outskirts of the city border on a polar taiga.

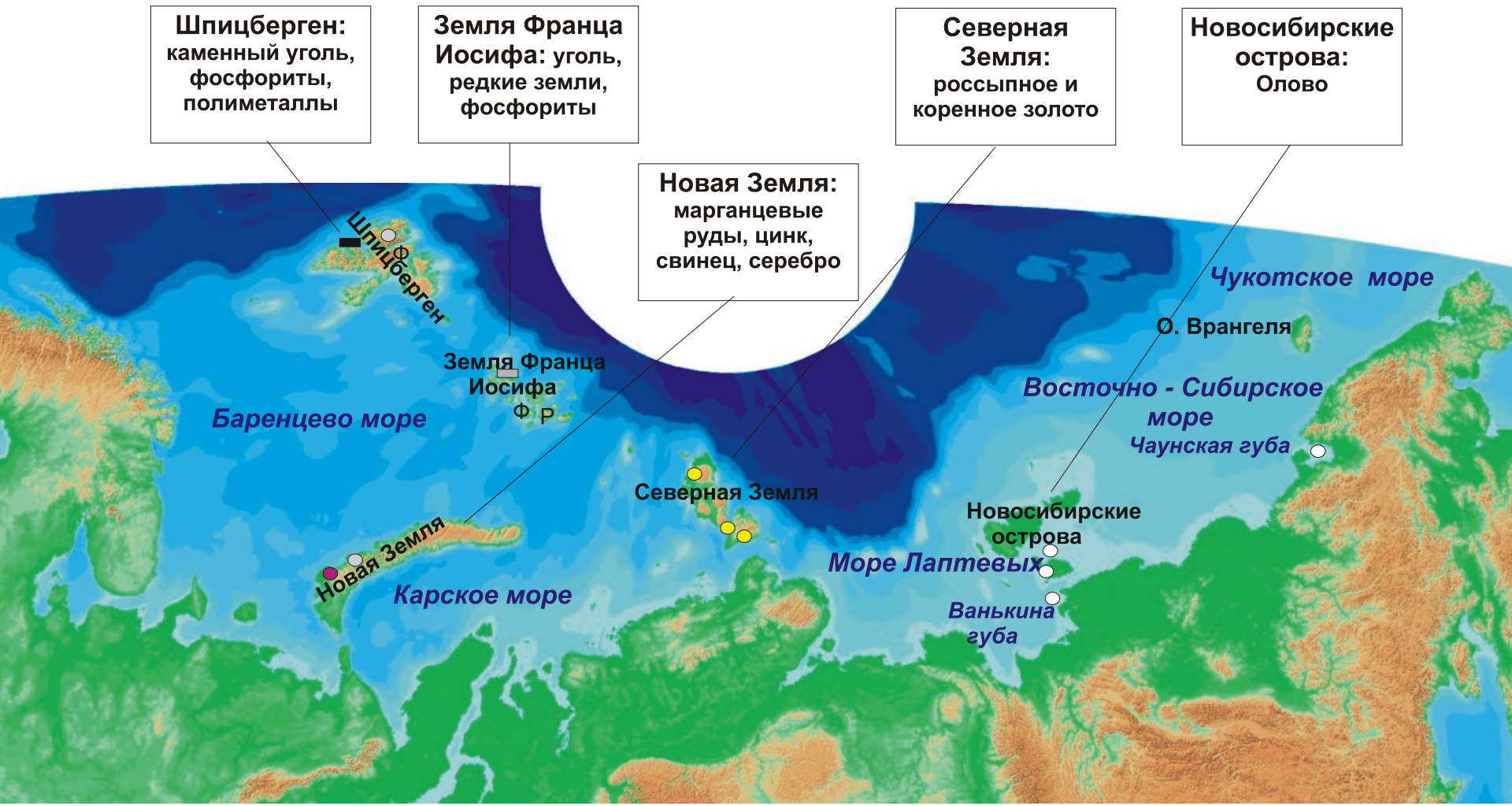
Polar night and Polar lights



Murmansk

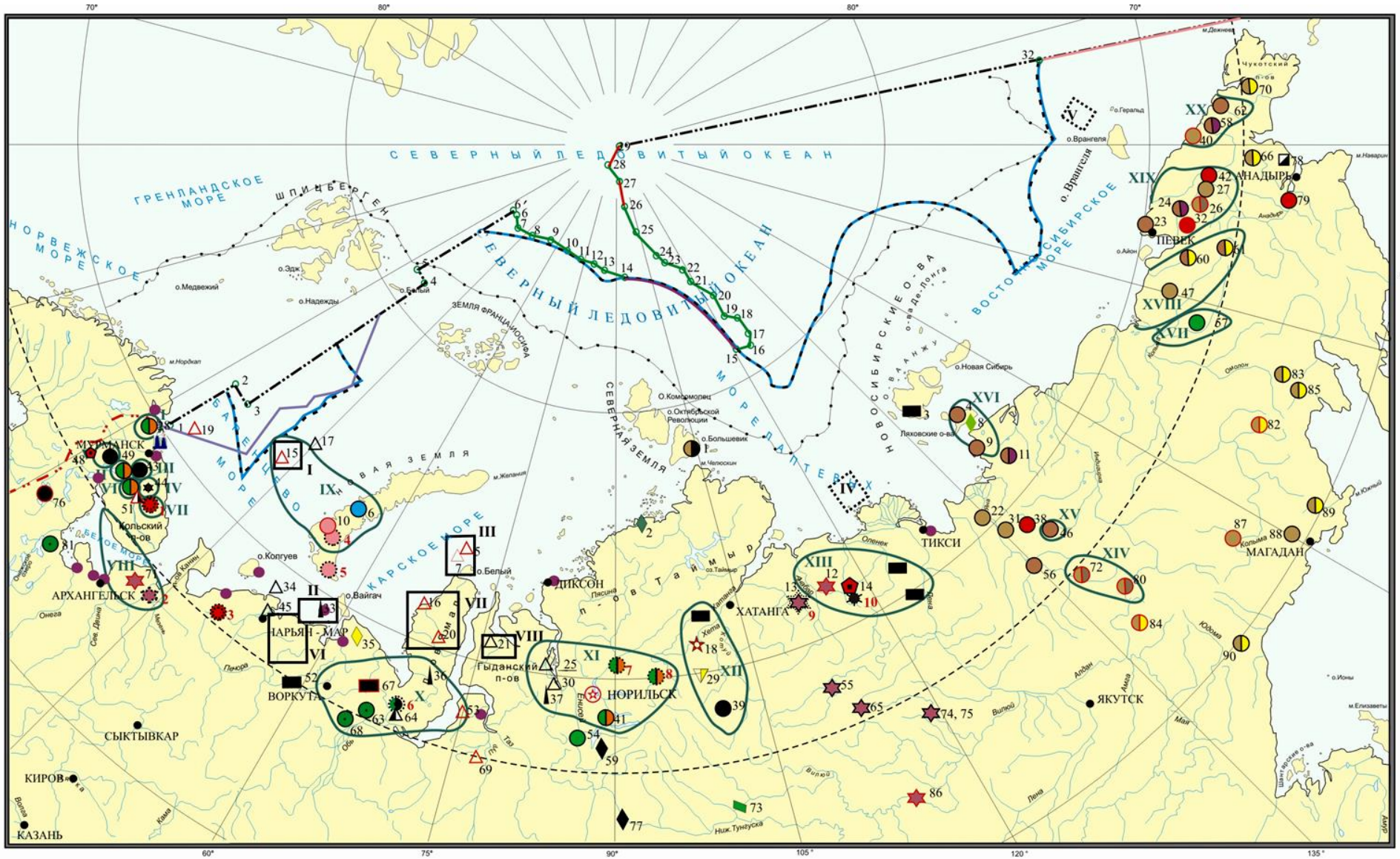
Norilsk – the second big city of our country which was located far beyond Arctic Circle. This city was created to master unique natural wealth of the Taimyr Peninsula. The number of its population is 176.6 thousand people. Norilsk is in 300 km to the north from the Polar circle. It is the city of permafrost. Even the summer is more two-month transition of whimsical spring to cold fall here. Frosts reach a mark of -56 °C in the winter.

Месторождения твердых полезных ископаемых на арктическом шельфе России и архипелаге Шпицберген



Условные обозначения: ● - золото, ○ - олово, ● - марганец, ● - цинк, свинец и серебро, Ф - фосфориты, Р - редкие земли, ▬ - каменный уголь, ▭ - бурый уголь.

Scheme of placement of fuel and energy and mining complexes



Pevek (in Chukchi Peekin,5327people). It is the most northern city of Russia. Time difference with the capital of Russia – 9 clocks. That is if in Moscow the working day, then in Pevek at this time soon morning and the beginning of the next day ended.

Here, in the Chaunsky district of Chukotka, **extraction of tin and gold, tungsten and silver, hydrargyrum and coal** is conducted.

Pevek – large Arctic seaport on Northern Sea Route, it plays an important role in economic and strategic development of the region. The navigation period in Pevek port lasts from July to November.

Nizhny Tagil, city-forming Uralvagonzavod plant

In the closest 10 years of Russia it is necessary to solve the difficult task of the choice of model invitation of northern territories and to divide what type of settlements will be dominated in different territories. On this process will affect, first of all, factors:

• Shift of zones of production of resources in zones, extreme for urbanization and the extremely difficult for deployment business activity (and respectively,
impossibility of broadcasting to the Soviet fashion -whether, that is constructions of new inhabited points);

• Deterioration in resource base in aged development zones (for example, degree explotation of explored reserves of deposits of naphtha and gas of Western Siberia are by different estimates from 43 to 60%), and corresponding, decrease in requirement in people resources and a exist
-
Russian system of resettlement which leans generally on rather large city educations;

The Barentsburg mine called by the name of the outstanding Dutch seafarer - the researcher of the Arctic Willem Barents, is located on east coast of Green fiord, Svalbard arkchipelago.

The rights for lands near Barentsburg the Norwegian, American, Russian-German and Dutch companies at different times owned.

Now the Russian company Arktikugol works there.

Norwegian captain Zakariassen has opend the coalfield on the cape Heer in 1899. From 1932 Arktikugol trust working in Barentsburg mine including the mine, power plant, the port, mekhanic department, the motor transportation park warehouse and housing and communal services, the greenhouse, the sewing shop, hospital, etc.

Spitsbergen or as Norwegians — Svalbard speak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215
221
217
251
242
249
253
252
209
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Population of the mine about 300 people. The mine is characterized by high extent of mechanization of productions, the bound to coal mining. From the clearing faces which are approximately at a depth over 500 m, the combine layer of coal with a power about 1.5 m collapses, and the beaten-off coal is loaded on the conveyor; at the same time the developed space fastens.

On a current circuit of the excavations called conveyor drifts, a bias, the adit the extracted coal conveyors is delivered to a technological complex of a surface, and further goes to an internavigation warehouse and partially - to concentrating installation. Concentrating installation was mounted and opened up in 1996 in this connection the quality of the shipped coals increased.


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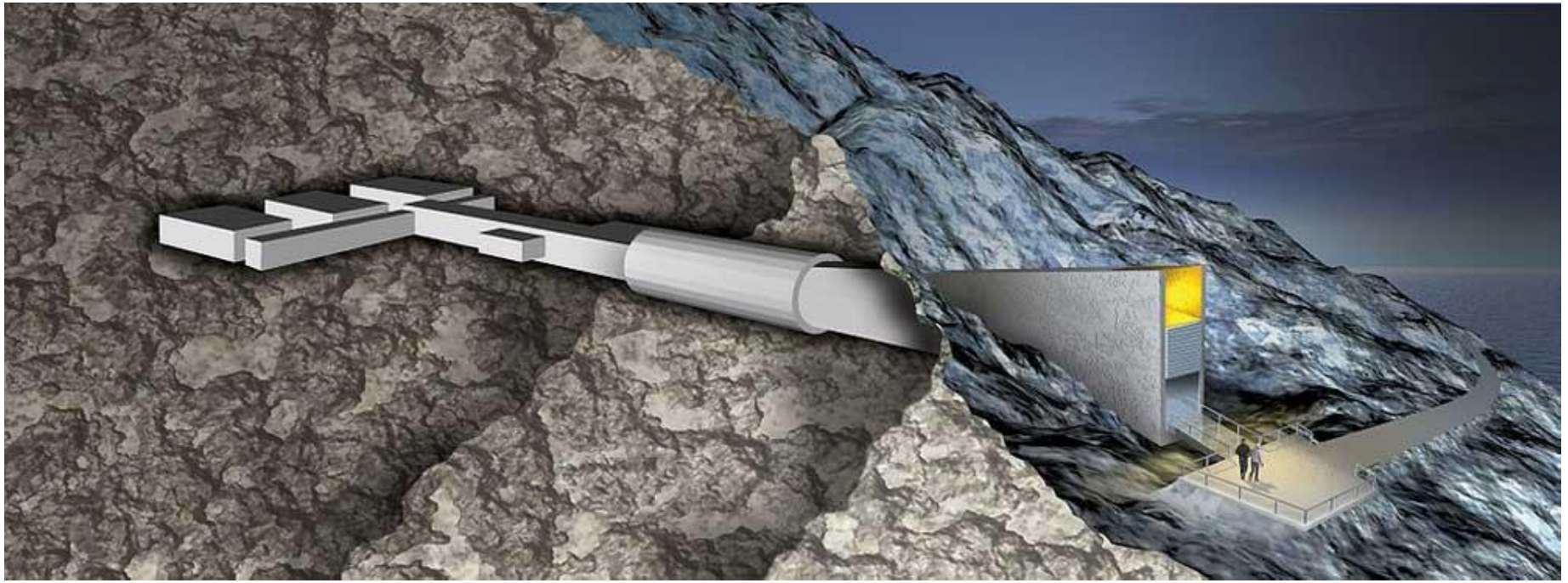
On February 26, 2008, on the island of West Spitsbergen near the city of Longyearbyen (Norway) the ceremonial opening of the World storage of seeds was held.



"The storage of the Doomsday" is at a 120-meter depth in the rock and at the height of 130 meters above sea level.

The project purpose - preservation of sowing material of all agricultural plants existing in the world on a case of natural or technogenic catastrophes.

In 1984 for its storage one of the abandoned mines on Spitsbergen was chosen.

The storage in the abandoned coal mine at a depth of 120 m underground and at the height of 130 m above sea level is located that guarantees it survival at a direct hit of a nuclear bomb or at sea level rise as a result of global warming. The storage is in permafrost zone (distance to the North Pole - 1309 km), temperature minus 3.5 degrees Celsius is naturally maintained inside, artificially it is cooled to minus 18 degrees that is optimum for storage of seeds.

In February, 2018 the number of the seeds which are contained in storage reached 983 thousand (all the volume of 4.5 million). According to the principles of the project, the largest National or supranational agricultural Institutes of the world send reserve seed material to it: now 73 organizations use its services. They possess all rights for the stored material. At the same time the government of Norway undertakes all expenses on storage of exemplars and their transportation to Spitsbergen (sending to the airport of Oslo is carried out at the expense of organizers-depositors).


10


IPK
BOX 71
BOX 70

Divers-sappers of Naval Forces of Estonia share in work of the camp organized by the Finnish naval forces at a deep-water calcareous pit of Oyamo in the Southern Finland.

Recultivation of Korkinsky coal mine (Chelyabinsk region) in model of filling with stowage material

МОДЕЛИРОВАНИЕ ЗАПОЛНЕНИЯ РАЗРЕЗА ЗАКЛАДОЧНЫМ МАТЕРИАЛОМ

Slate pits where extraction of slate ended, plant with trees, giving territories absolutely new purpose adequately to return them to the natural and vital environment. Most often at recultivation of pits of Eesti Energia planting of the woods is used. Pines and birches and also – an alder and an aspen land generally. Figuratively speaking the green strip constantly accompanies works on production as upgrading of the territory of production happens constantly on the activity course. For example, on Aydu's pit which completed the work last year as a result of it both the 5-year, and 50-year wood grows.

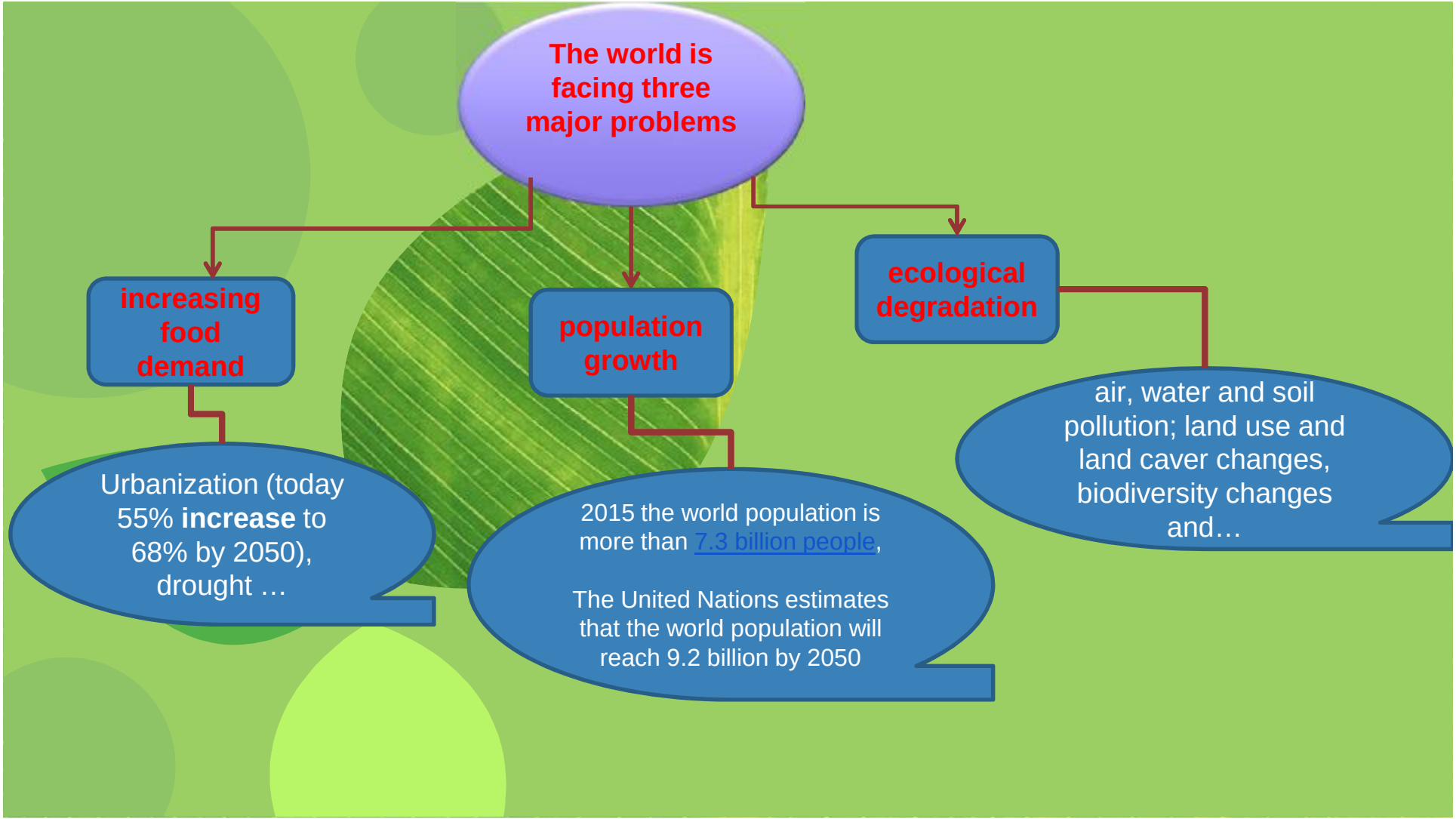
Thanks

Urban Agriculture, Management, Ecosystem Services

A. Rahimi

J. Breuste, R. Ghasemzadeh, V. Obermair

7-14 July 2009, SURE Summer School: Salzburg


The world is facing three major problems
increasing food demand
population growth
ecological degradation
Urbanization (today 55% **increase** to 68% by 2050), drought …
2015 the world population is more than 7.3 billion people,
The United Nations estimates that the world population will reach 9.2 billion by 2050
air, water and soil pollution; land use and land caver changes, biodiversity changes and…

Urban Agriculture (UA)

Urban agriculture (UA) is an alternative farming system based on small-scale local food production in an urban or peri-urban setting, and which often, but not necessarily, uses organic techniques and the principles of environmental sustainability. UA is a common source of income and coping mechanism in many cities in developing countries (e.g. De Bon et al. 2010; Lee-Smith 2010).

Advocates of UA seek consumer support by highlighting the environmental benefits of UA, such as reduced greenhouse gas emissions and enhanced biodiversity in cities (Pataki et al. 2011; but see Kulak et al. 2013).

UA is the collective name for a wide variety of farming activities that occur within the boundaries of a city. For example: allotment garden, community garden, private garden and… (Aerts et al., 2016)

Today, urban agriculture is being manifested by policy makers, government agencies and academics due to its contribution to food security and poverty alleviation

urban agricultural activities can contribute to the availability of fresh and nutritious food items, reduction in food expenditure on food bills, having direct access to varieties of food products as well as urban waste recycling, pollution and sustainability

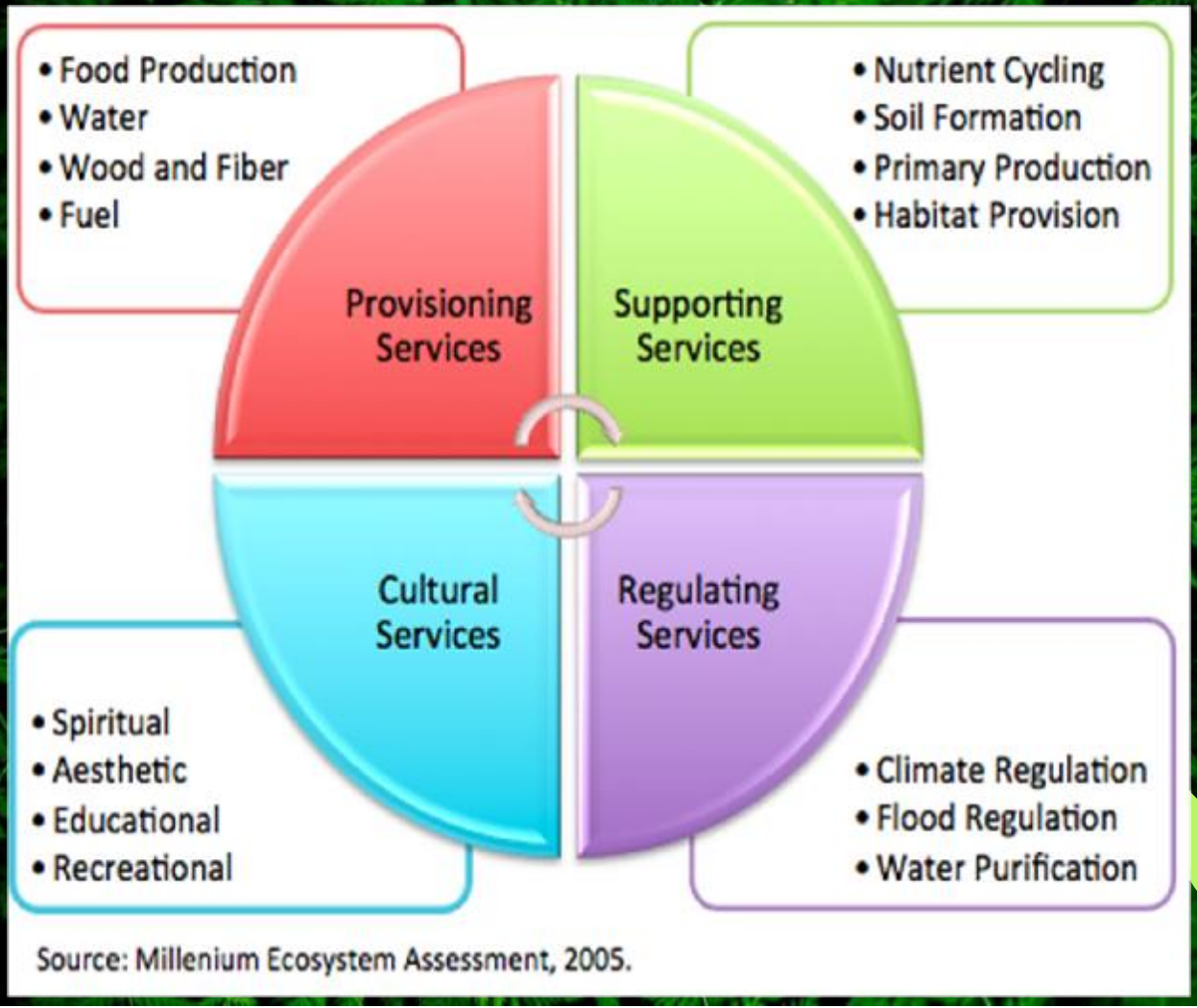
Urban agriculture is defined as any agricultural activities which grows, raises, processes and distributes agricultural products regardless of land size and number of human resources within the cities and towns (FAO, 2000).

urban agriculture

The term "urban agriculture area" is mostly referred as urban gardening from citizen on either public space or private gardens

Urban agriculture is a good way to increase the economic, environmental and social effects form growing food in and around urban areas

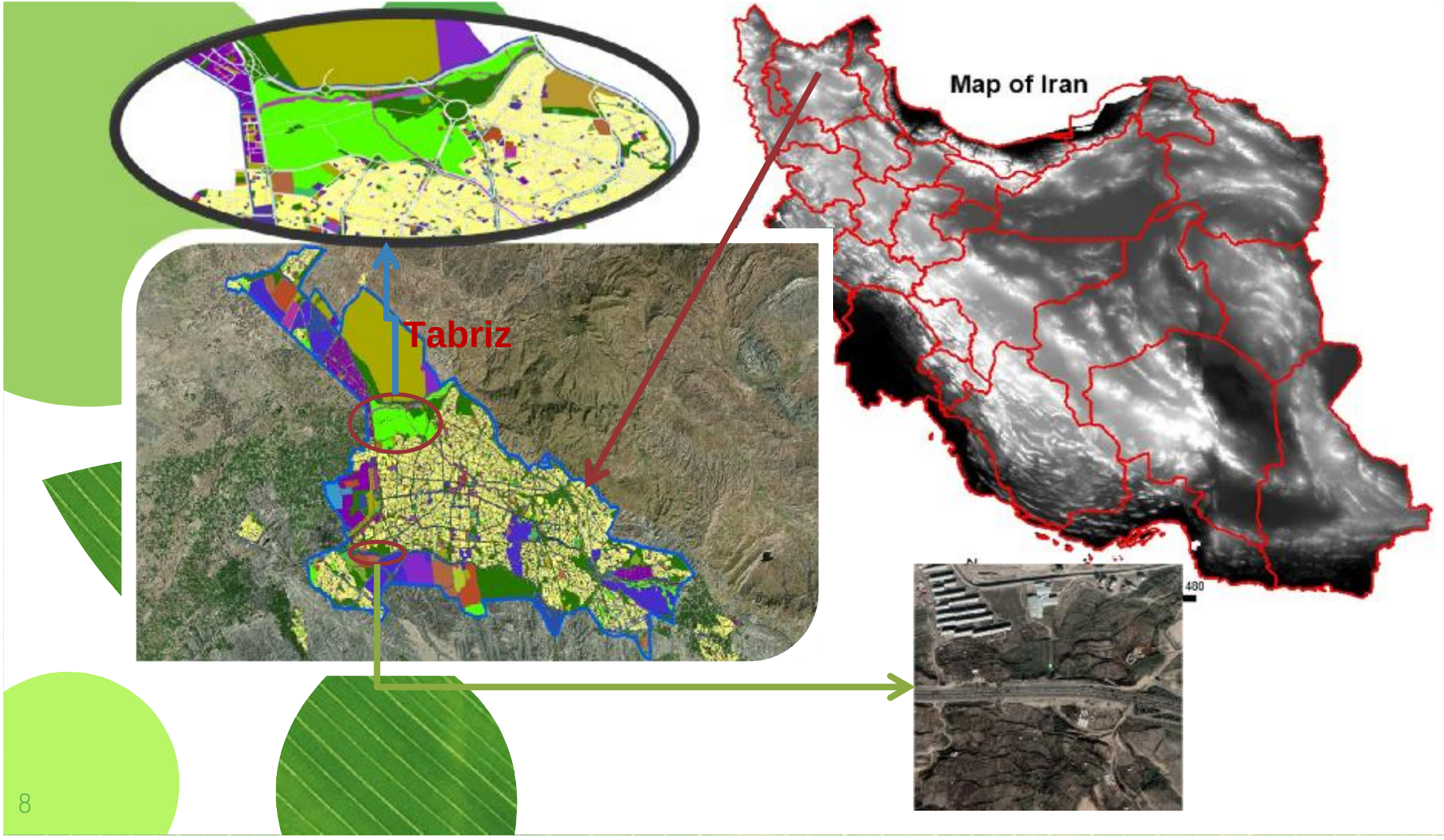
Ecosystem services are the benefits provided to humans through the transformations of resources (or environmental assets, including land, water, vegetation and atmosphere) into a flow of essential goods and services e.g. clean air, water, and food (Constanza et al. 1997).



UA and ES

Service	Small UA	Large UA*	Notes
Provisioning services			
Food	+	++	Size constraints limit yields; important at the local scale
Fiber	-	+/-	Green manure may have fibers but is preferably used to improve soil fertility
Fuel	+/-	+/-	Woody biomass is preferably recycled
Genetic resources	+	++	Small scale allows use of old or non-commercial varieties and land races
Biochemicals, medicines	+/-	+	Feasible but uncommon
Fresh water	-	--	Consumes water
Regulating services			
Air quality regulation	-	+/-	Limited and potential negative health effects
Climate regulation, local	-	+	Size constraints limit local climate regulation
Climate regulation, global	+/-	+/-	Avoided transportation expected to contribute to reduction of global emissions but effect is probably limited; indirect reductions of emissions via diet change expected
Water regulation	+	++	Increases infiltration, retention and transpiration; may control storm water
Erosion regulation	+	+	Cover prevents erosion
Water purification	+	++	Infiltration and retention prevents overspill from sewers, improves surface water quality
Waste treatment	+/-	+	Recycles organic waste flows as fertilizer
Human disease regulation	+/-	+/-	Long-term health risks not known
Pest regulation	+	+	Small-scale and avoidance of monocultures minimize incidence of pests
Pollination	++	++	Supports native pollinator communities
Cultural services			
Cultural	++	++	Reconnects consumers to food production
Social relations	++	+++	Improves urban social networks
Knowledge system	+	++	Conserves old gardening/farming methods
Aesthetic values	+++	++	Improves quality of urban life
Education/Recreation	++	++	Improves urban ecological structure

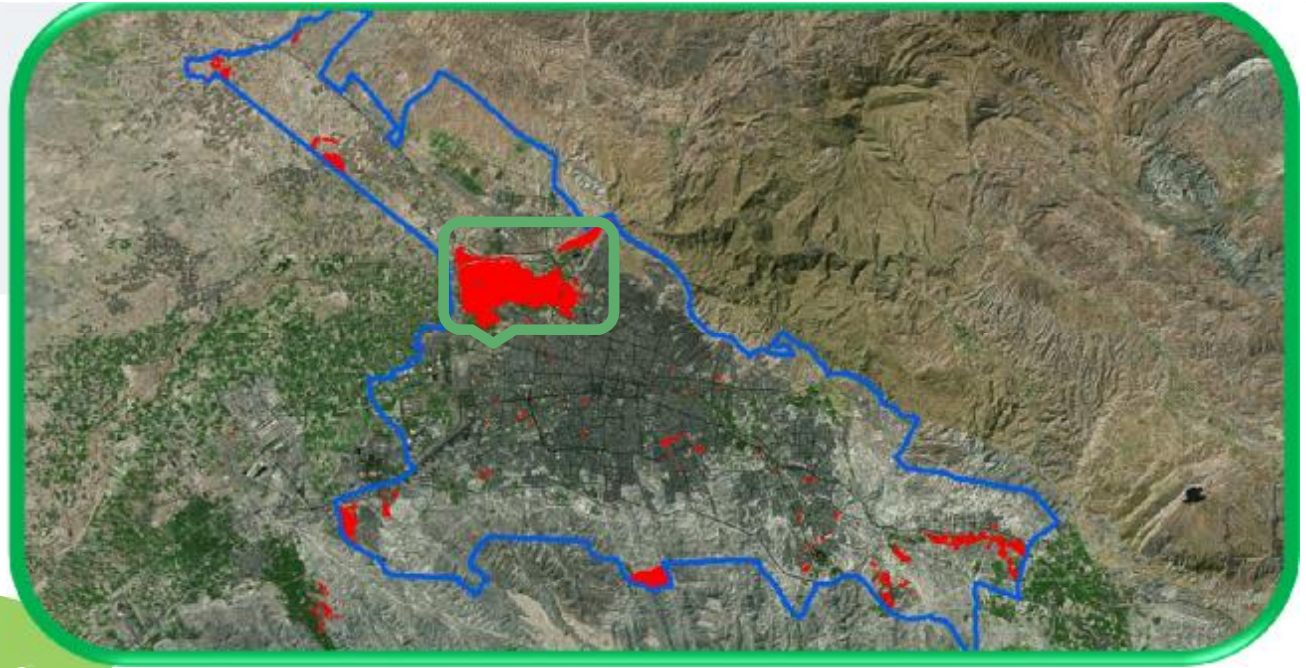
(Aerts et al., 2016)


Map of Iran
Tabriz

Tabriz is the center of East Azerbaijan Province and has 1.77 million inhabitants of according to the population and housing census of 2016. Tabriz is located in a valley to the north of the volcanic cone of Sahand Mountain. In the last century, Tabriz was surrounded by gardens, had a favorable climate, and Tabriz strategic situation and good climate condition caused that during different periods in history, Tabriz was chosen to be the capital of Iran. But the recent expansion of Tabriz has destroyed gardens and green areas and has already started to affect favorable climate of the city. Like other populated cities in the developing countries, Tabriz had rapid urban growth leading to the formation of informal settlements in peripheral zones of the city.

Hokmabad

- Hokmabad is located at the north – west edge of Tabriz next to the Airport
- Widest urban agricultural area
- Mostly vegetables are plant there and usually no animals kept
- The surrounding area offers a leisure park



850 hectares
Approximately 740 he in Hokmabad
110 he in Laleh

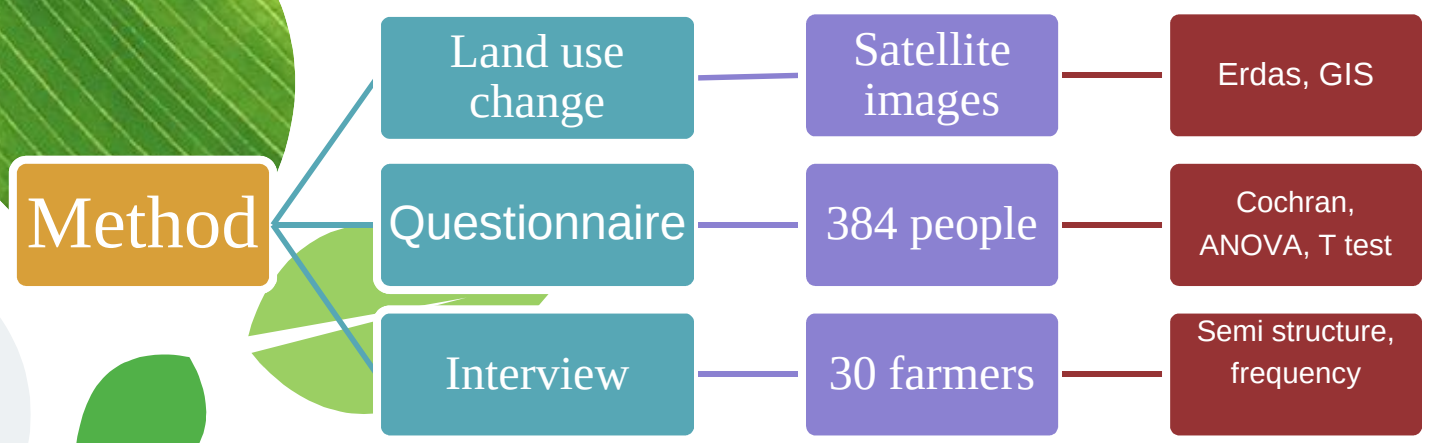
Hokmabad
UA

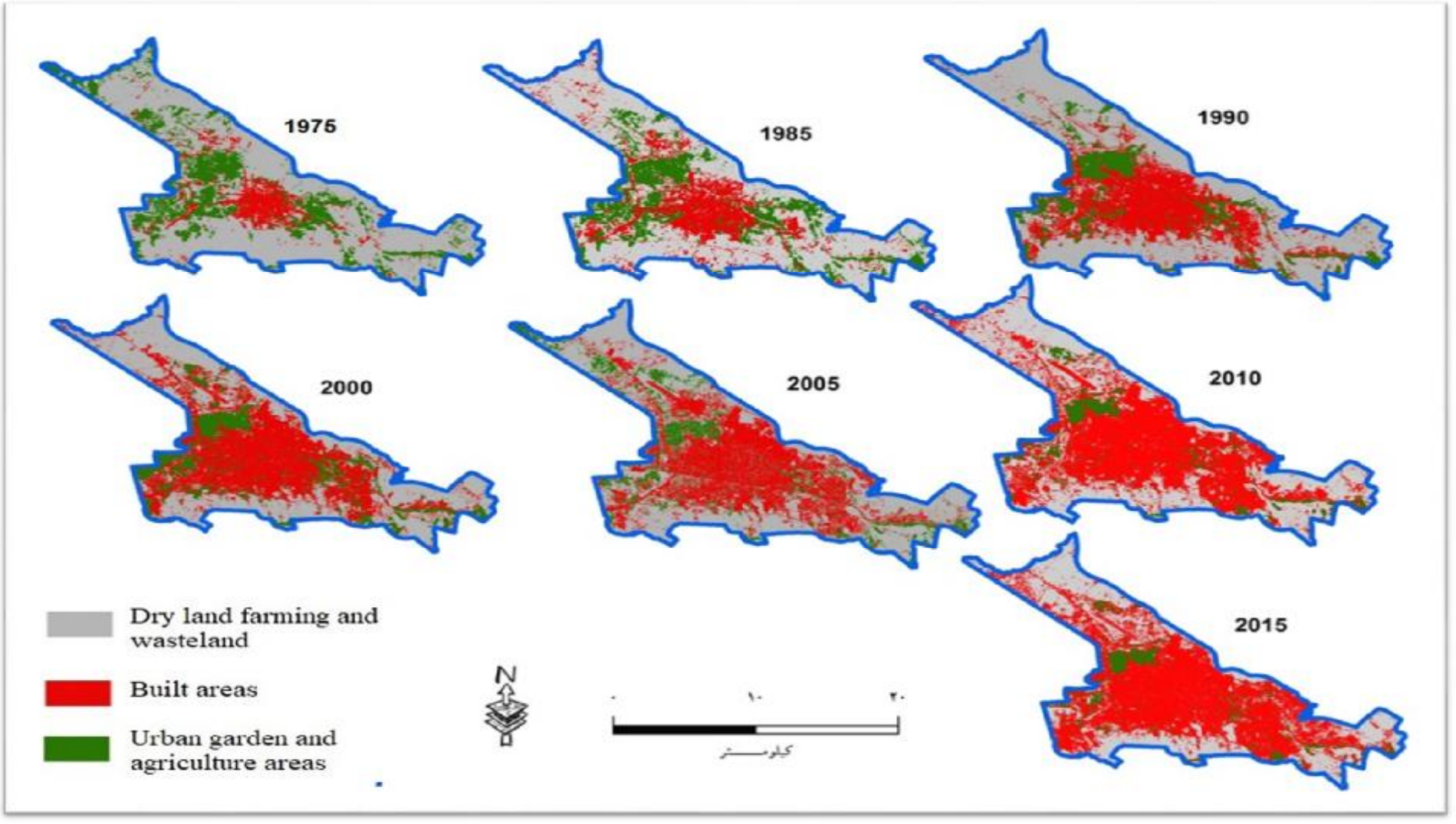
The farmers sell their products on the markets in the farmlands

Laleh

- The area is located at the south – western edge of the city next to a highway.
- There are some chickens kept.
- New homes were built in this area, demolishing fields.
- Farmers sell alongside the highway amongst others

Tabriz urban agriculture evaluation in this work



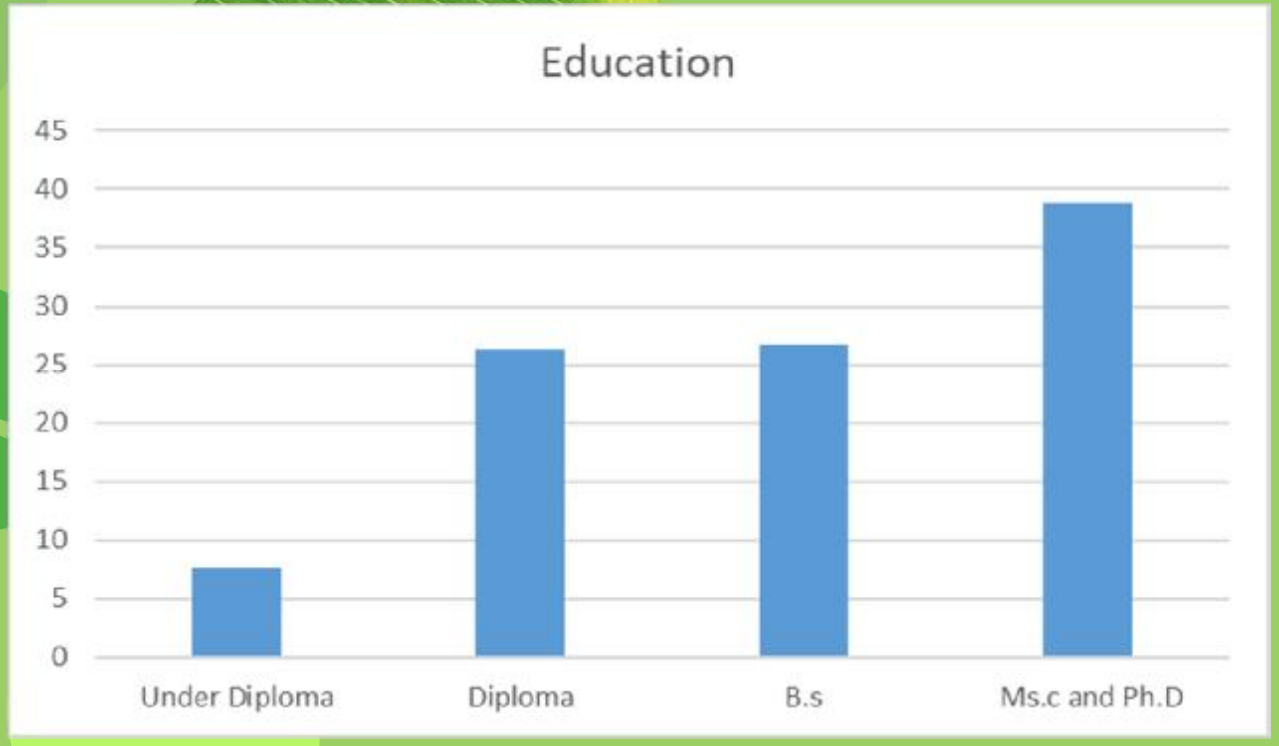

1975
1985
1990
2000
2005
2010
2015
Dry land farming and wasteland
Built areas
Urban garden and agriculture areas
N
۰
۱۰
۲۰
کیلومتر

land use	1975	1985	1990	2000	2005	2010	2015
	areas	areas	areas	areas	areas	areas	areas
Dray land farming and wasteland	17032.07	15076.24	13464.13	11902.85	9587.23	11132.39	9623.06
Built areas	2430.69	4672.44	6790.13	8823.59	4256.25	12130.81	14047.21
Urban gardens, agriculture land and parks	5916.53	5630.61	5125.03	4652.85	3535.81	2116.09	1709.02
Sum	25379	25379	25379	25379	25379	25379	25379

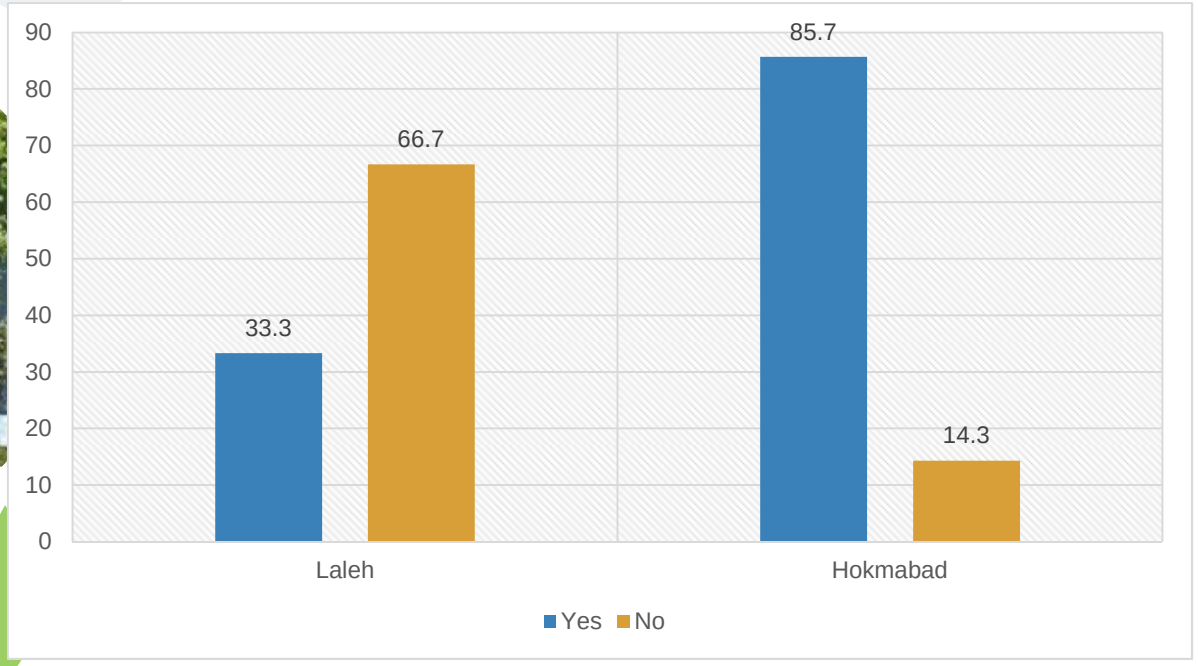
land use		1985	1990	2000	2005	2010	2015
	percent	percent	percent	percent	percent	percent	percent
Dray land farming and wasteland	67.11	59.4	53.05	46.9	37.78	43.86	37.92
Built areas	9.58	18.41	26.75	34.77	16.77	47.8	55.35
Urban gardens, agriculture land and parks	23.31	22.19	20.19	18.33	13.9	8.34	6.73
Sum	100	100	100	100	100	100	100

Important results from the Questionnaire

Demographic Information

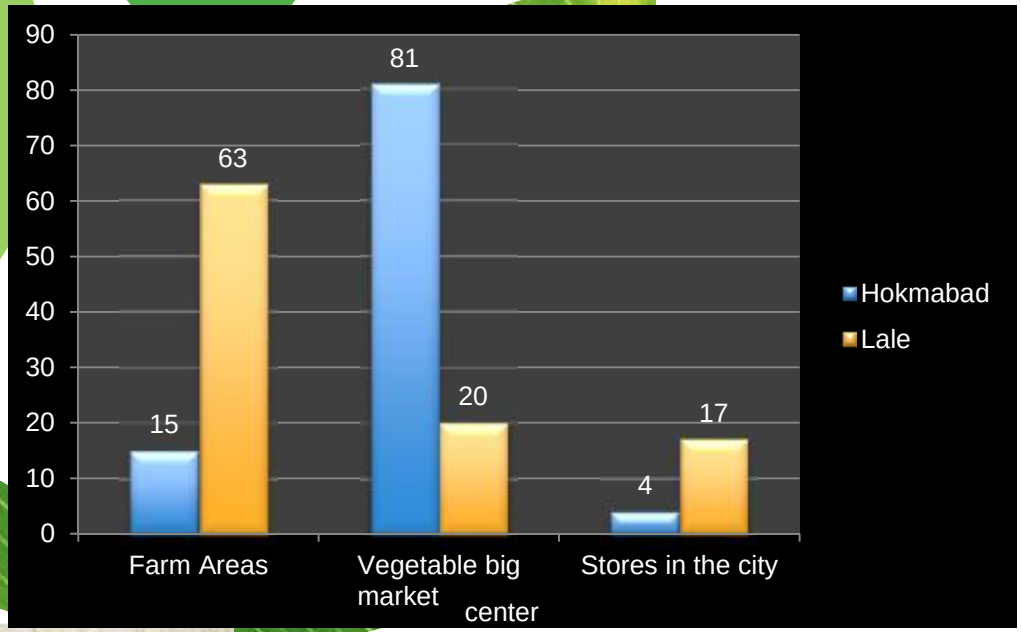


Is it their main source of income?



Hokmabad: retired, army, taxi driver
Laleh: retired, teacher

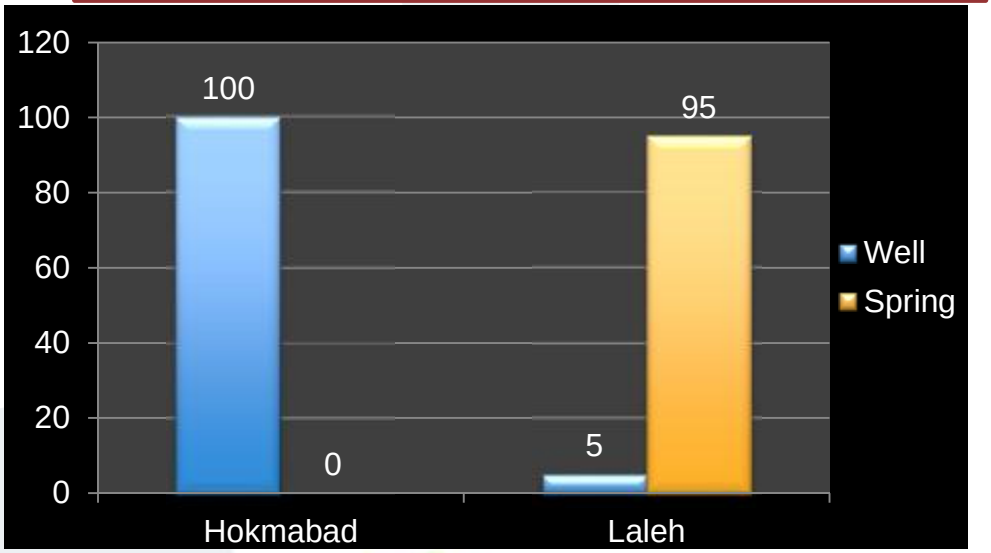
Where do they sell their products?



East Azerbaijan,
Tehran
West Azerbaijan

Farmers sell their products near the road (main roads and highway)

Where do they get water for irrigation?

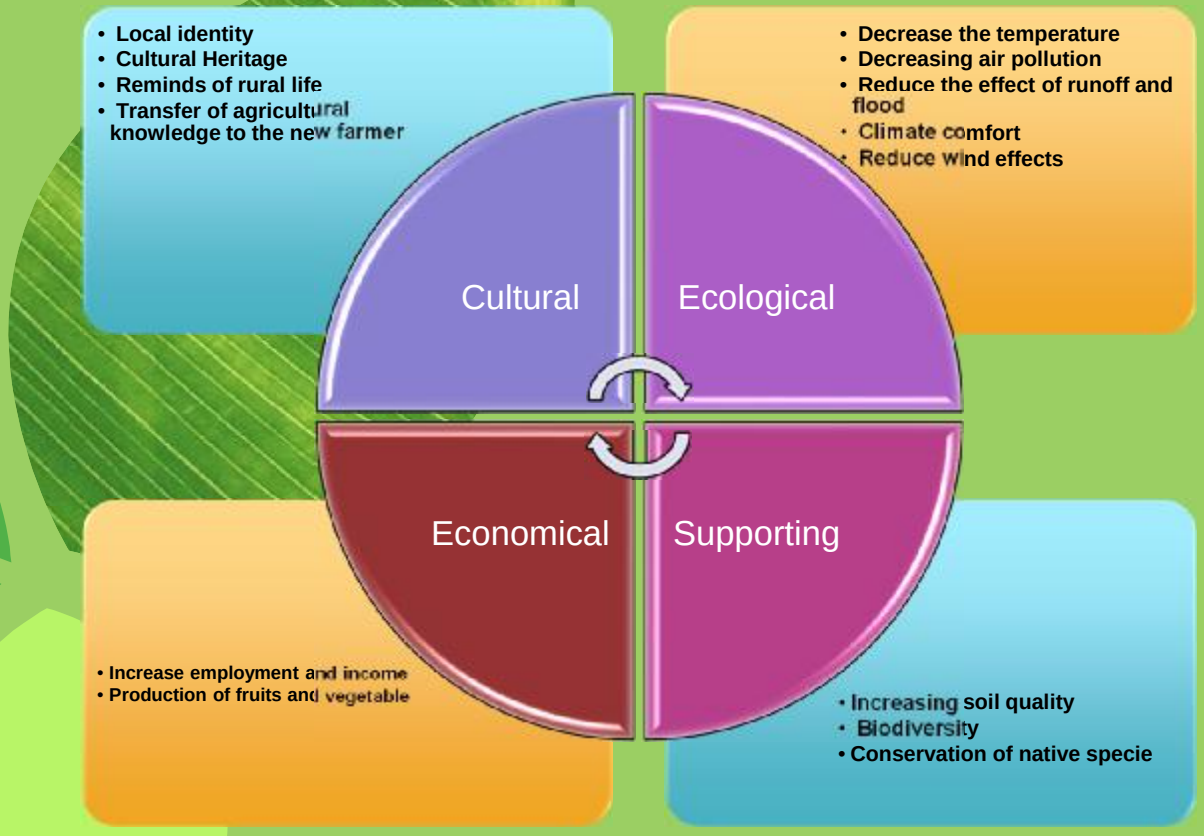


Main problems:

- Water for irrigation
- governmental Limitation
- UA are changings into apartments

1. Ecological
2. Economic
3. Cultural
4. Supporting

The main reason to protect UA and ES



Important results from the interview:

1- 100% of the farmers want to save the lands they are working on. (income, job for family).

2- 100% of the farmers believe that farming is an important job not only for themesleves but also for the society.

3- The only legeal limitation farmers are facing is the Municipality.

Discussion

Why urban agriculture is important in Tabriz?

- Food security: Many families who work there or live close there are poor families. And they can bay fruits and vegetables at very low prices.
- Job opportunity: 2000 family Not People, Work there.
- Recreation areas: Many people come there for picnic, for dinner, for visiting UA, buying direct from farmers,
- Ecological services

Legal limitation for urban agriculture

This is a new approach in Iran (most of gardens and UA areas destroyed after Iranian modernism development in urban areas)

In master and detail plan of Iranian cities, No agriculture areas(public green areas like parks, garden)
The land use of UA is Park????

Credits

Special thanks to all the people who manage this summer school.

Thanks!

ANY QUESTIONS?

You can find me at

- akbar.rahimi@gmail.com

FROM PLANNING GREEN NETWORK TO GREEN INFRASTRUCTURE. ESTONIAN CASE STUDY

Prof. Kalev Sepp
Estonian University of Life Sciences

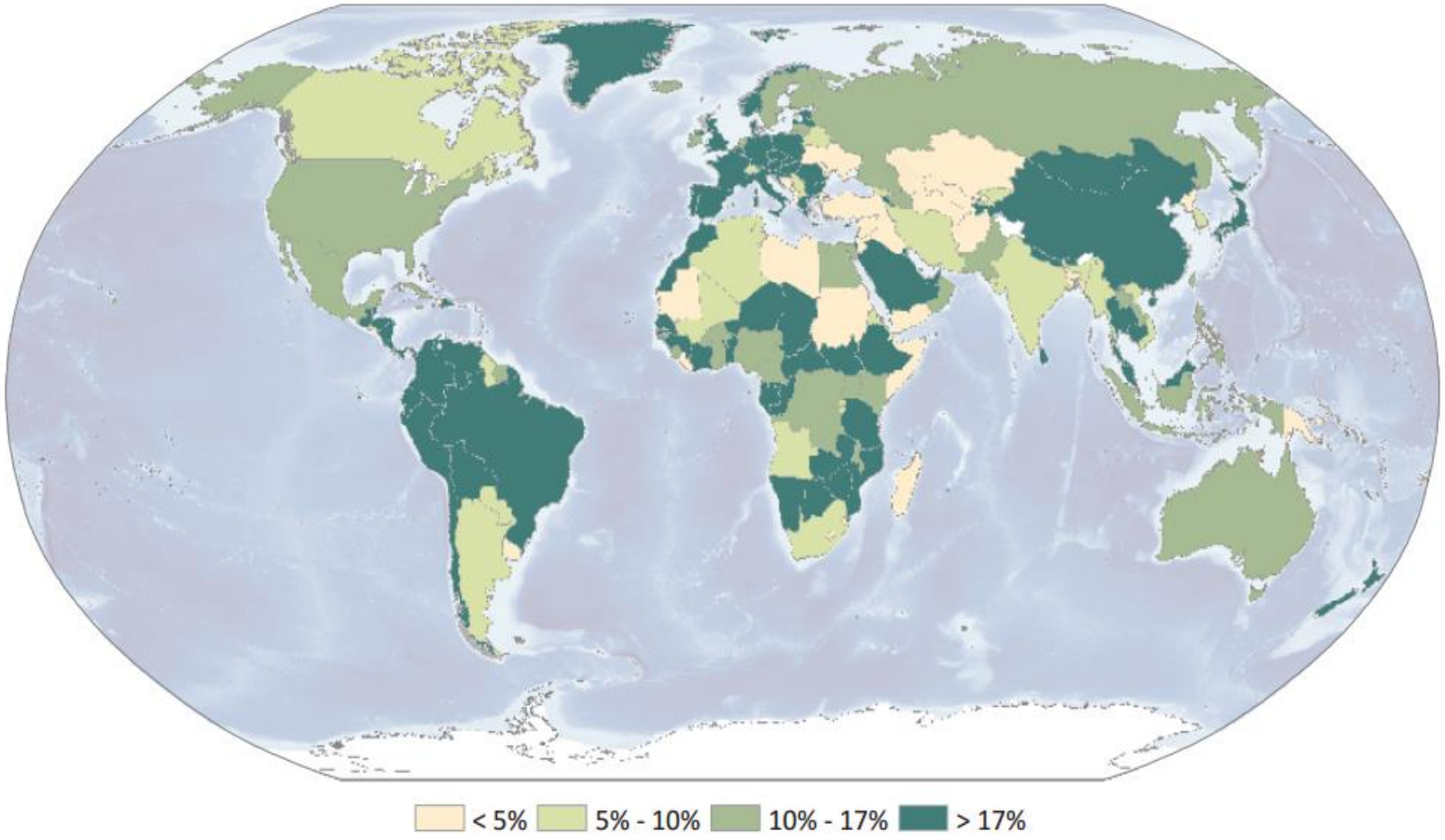
FRAMEWORK FOR LANDSCAPE PLANNING AND MANAGEMENT

- How should the landscape be described?
- How does the landscape operate?
- Is the landscape working well?
- How might the landscape be altered?
- What differences might the changes caused?
- Should the landscape be changed? How is the decision to be made?

IUCN

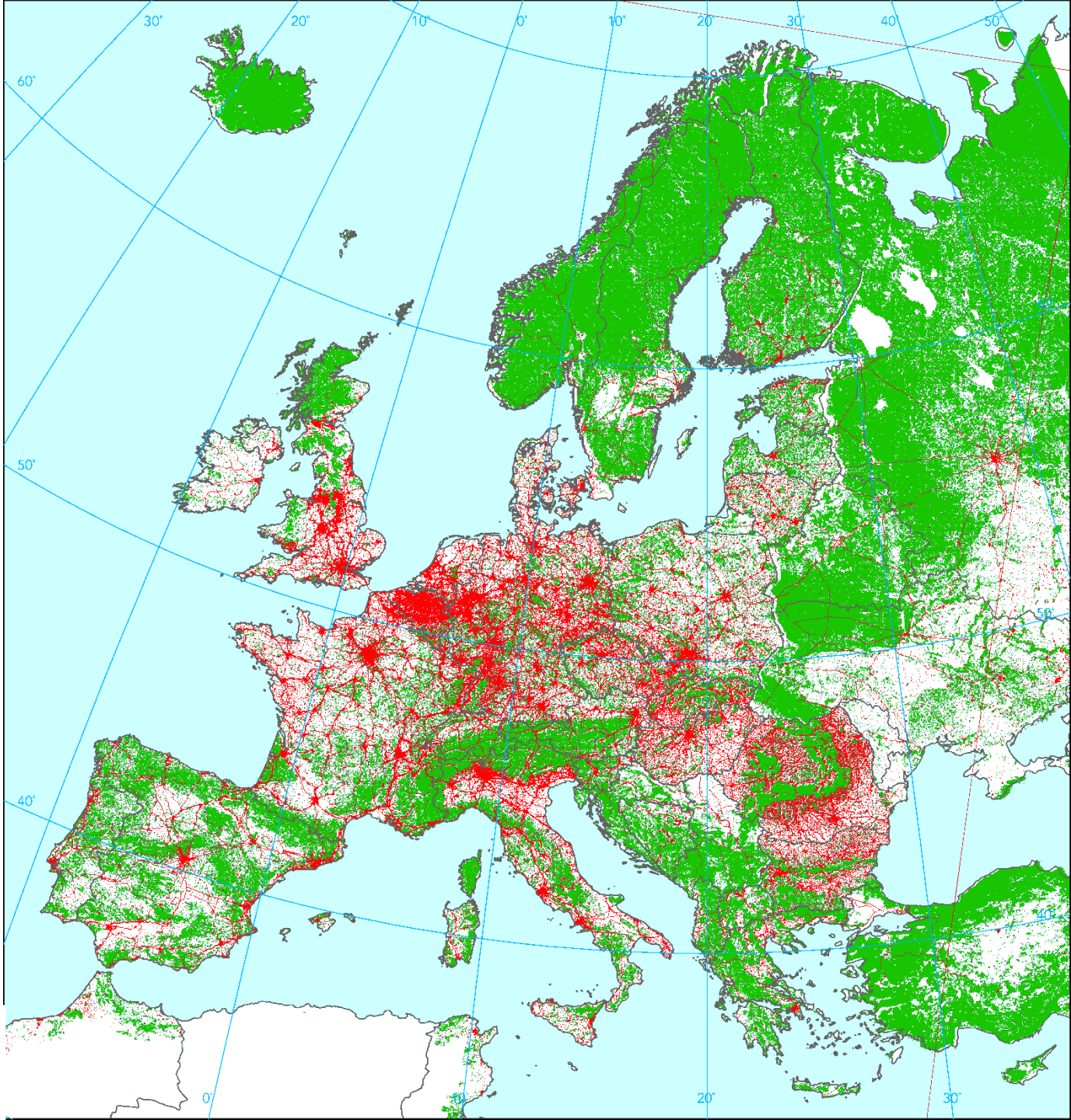
LANDSCAPE WITH A BIRD'S-EYE VIEW

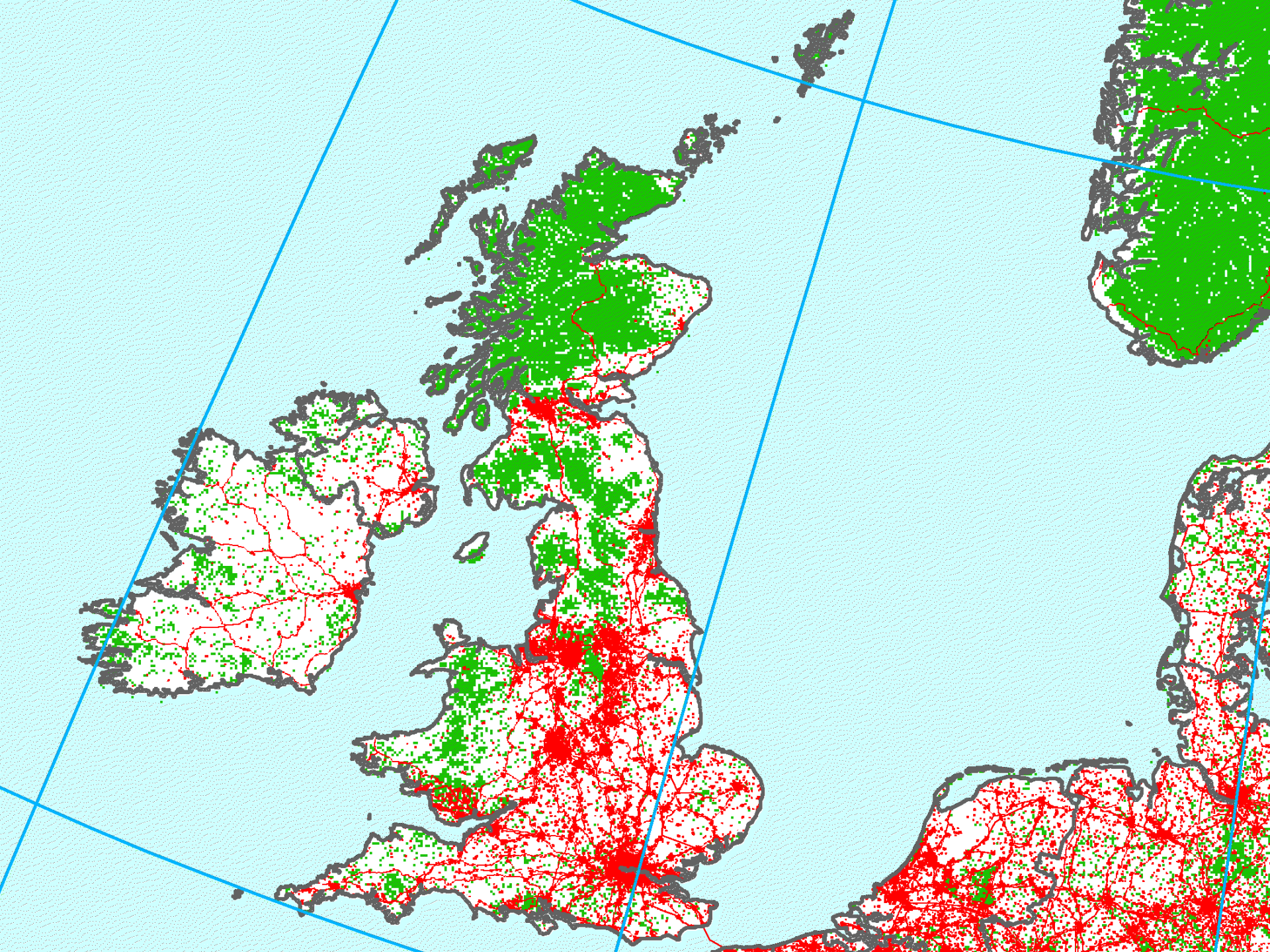
PROPORTION OF PROTECTED AREAS



IUCN

- How does Europe look like at present?
- Strongly urbanised, big differences between urban and rural



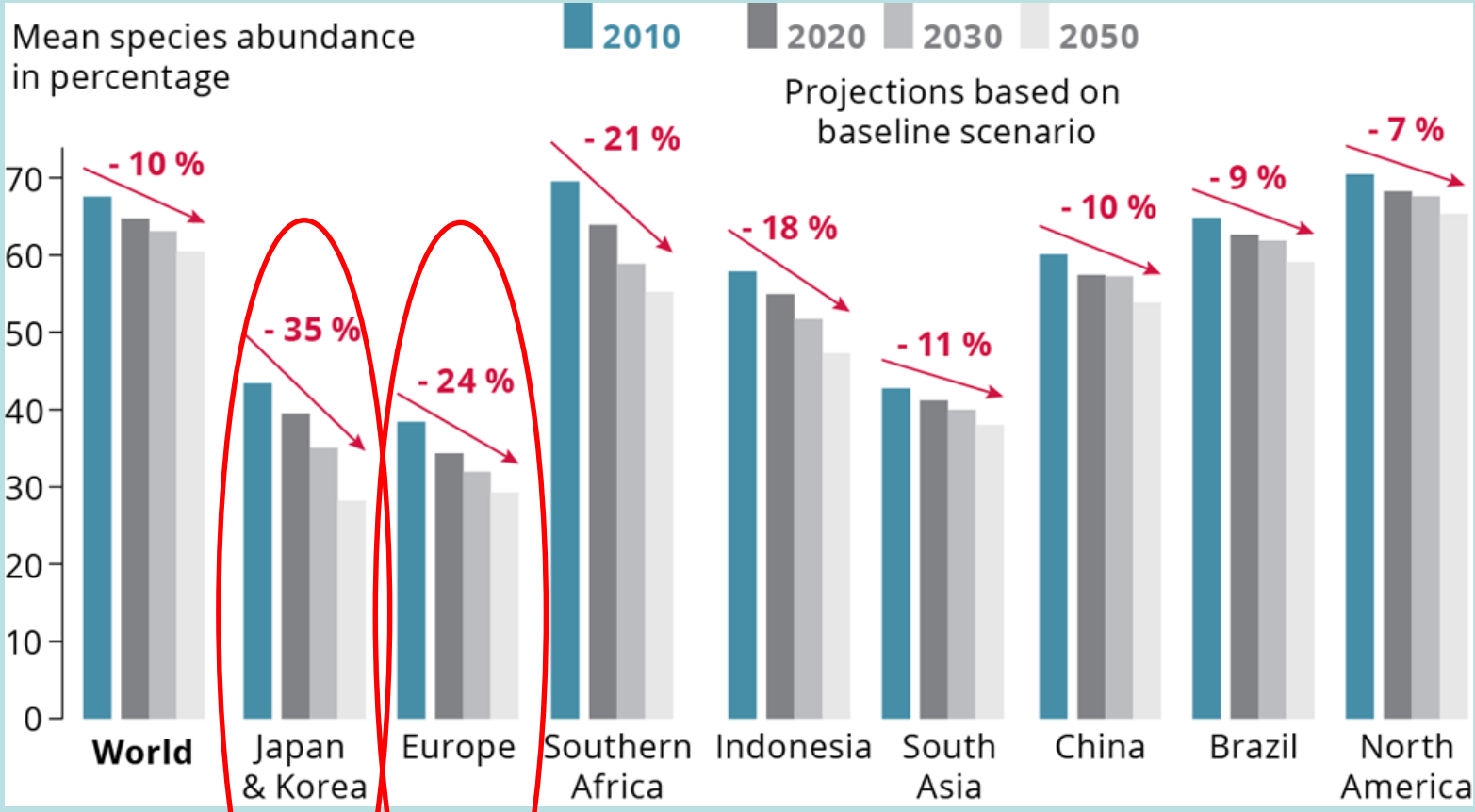


MAJOR THREATS TO GLOBAL BIODIVERSITY

- Destruction of habitats
- Habitats fragmentation
- Pollution of habitats
- Global climate change
- Over-exploitation of species for human consumption
- Invasive alien species

Source: State of Environment Report 2015, European Environment Agency

GLOBAL MEGATREND:
Rising pressure on ecosystems

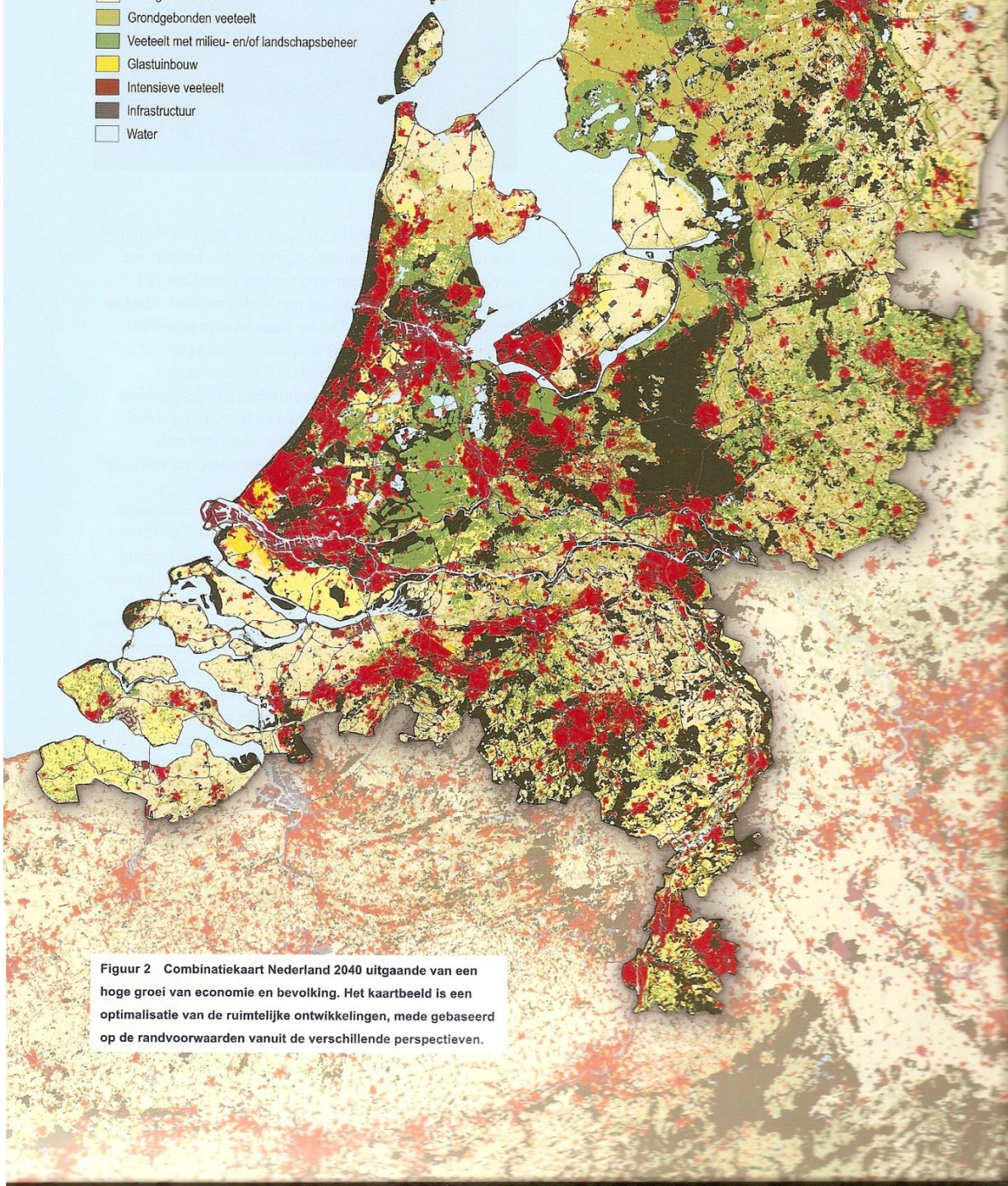


	World	Japan & Korea	Europe	Southern Africa	Indonesia	South Asia	China	Brazil	North America
Population:	7,3 mlrd	178 mln	742 mln	?	252 mln	?	1,3 mlrd	204 mln	565 mln
Density (inh/km^2):	54	**>400**	**116**	?	**132**	?	**142**	24	>20

Source: UN

Human society creates barriers of all kind

- At the regional scale:
- Urbanisation means barriers, but it does not mean that there is no nature or landscape



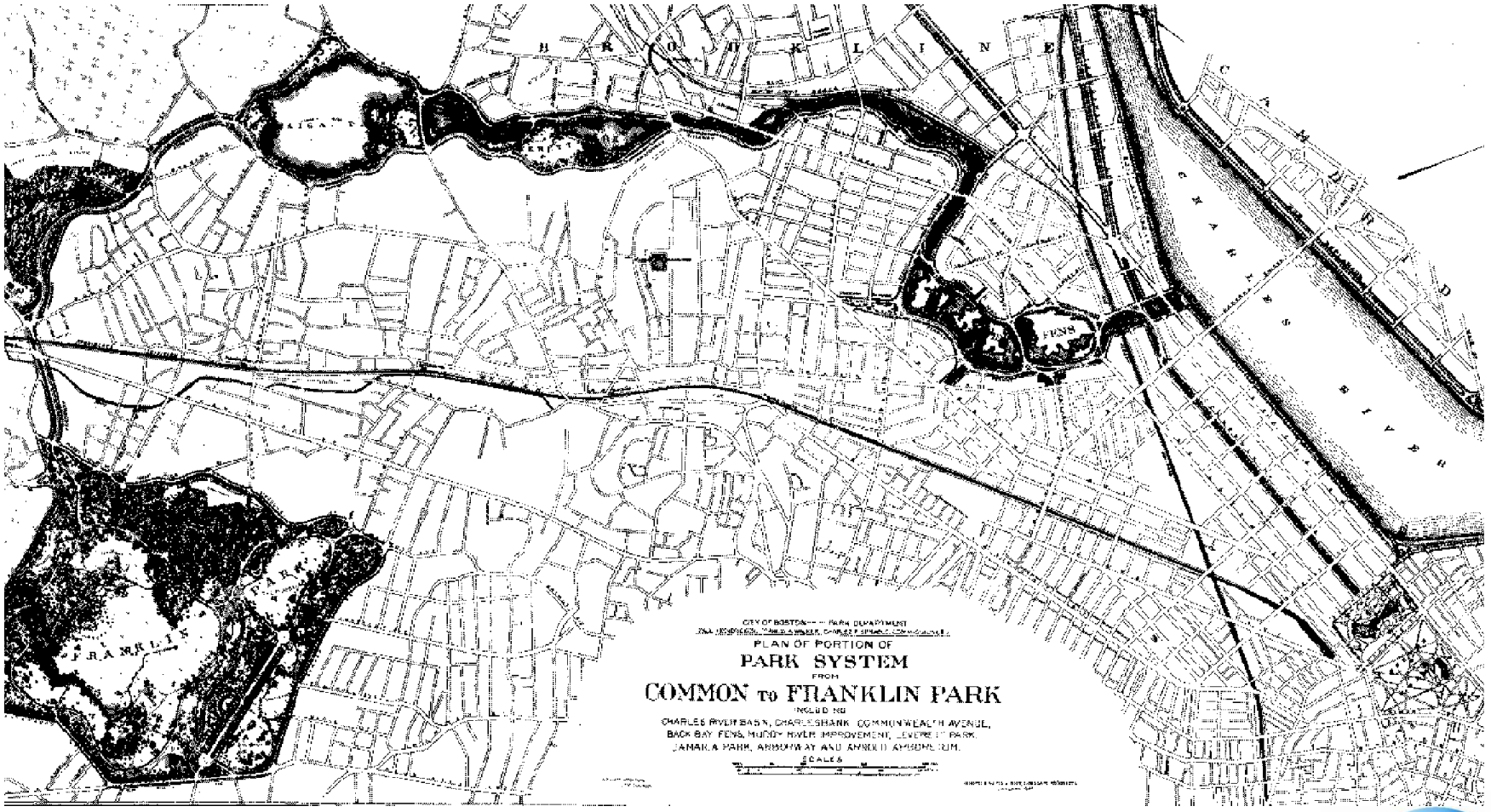
Figuur 2 Combinatiekaart Nederland 2040 uitgaande van een hoge groei van economie en bevolking. Het kaartbeeld is een optimalisatie van de ruimtelijke ontwikkelingen, mede gebaseerd op de randvoorwaarden vanuit de verschillende perspectieven.

Is the Green Infrastucture a new concept?
What we can learn from our previous experinces?

GREENWAYS, ECOLOGICAL NETWORKS AND GREEN INFRASTRUCTURE IN A SHORT HISTORY

- **Parkways:** Landscape Architectural concept of Frederick Law Olmstead (19th century): connected systems of parks and greenways being more beneficial than isolated green spaces.
- **Green infrastructure**: Edward T. McMahon (The US Conservation Fund): ". . . an interconnected network of protected land and water that supports native species, maintains natural ecological processes, sustains air and water resources, and contributes to the health and quality of life for people."
- European Commission: … is addressing the **spatial structure of natural and semi-natural areas** but also other environmental features which enable citizens to benefit from its multiple services.

THE EMERALD NECKLACE, BOSTON (USA)



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BACKGROUND: HISTORY

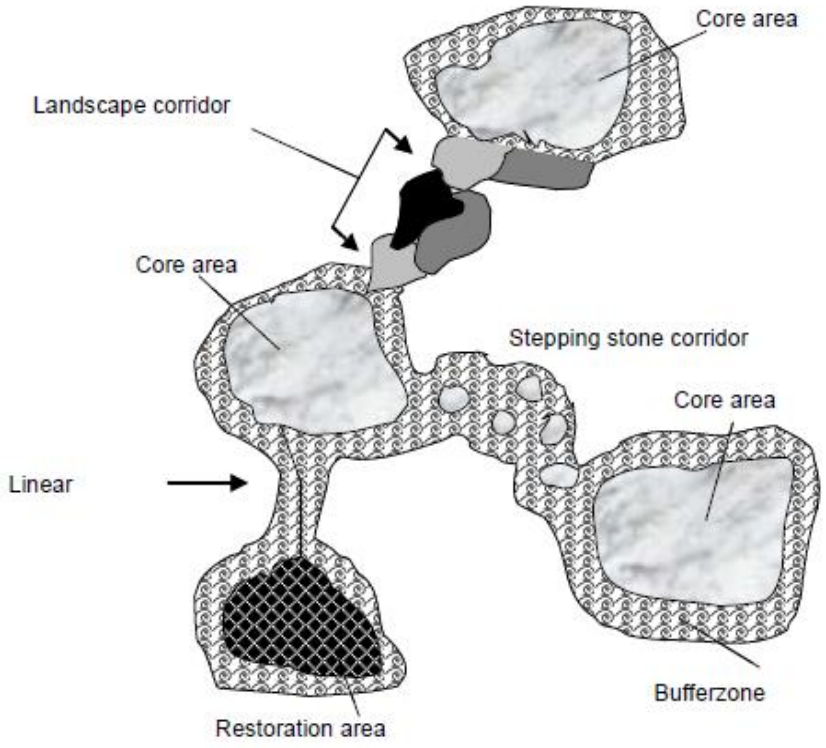
- The concept of ecological networks is not new; the model has developed over the past 35-40 years.
- Beginning in the 1970s and 1980s in countries where a strong land use planning tradition had created the institutional environment for allocating functions at the landscape scale in the context of increasingly fragmented European landscapes.
- The concept is the translation of ecological knowledge on fragmentation processes in the landscapes of Europe and its consequences for populations of natural specie.

WHY? BACKGROUND - POLITICAL

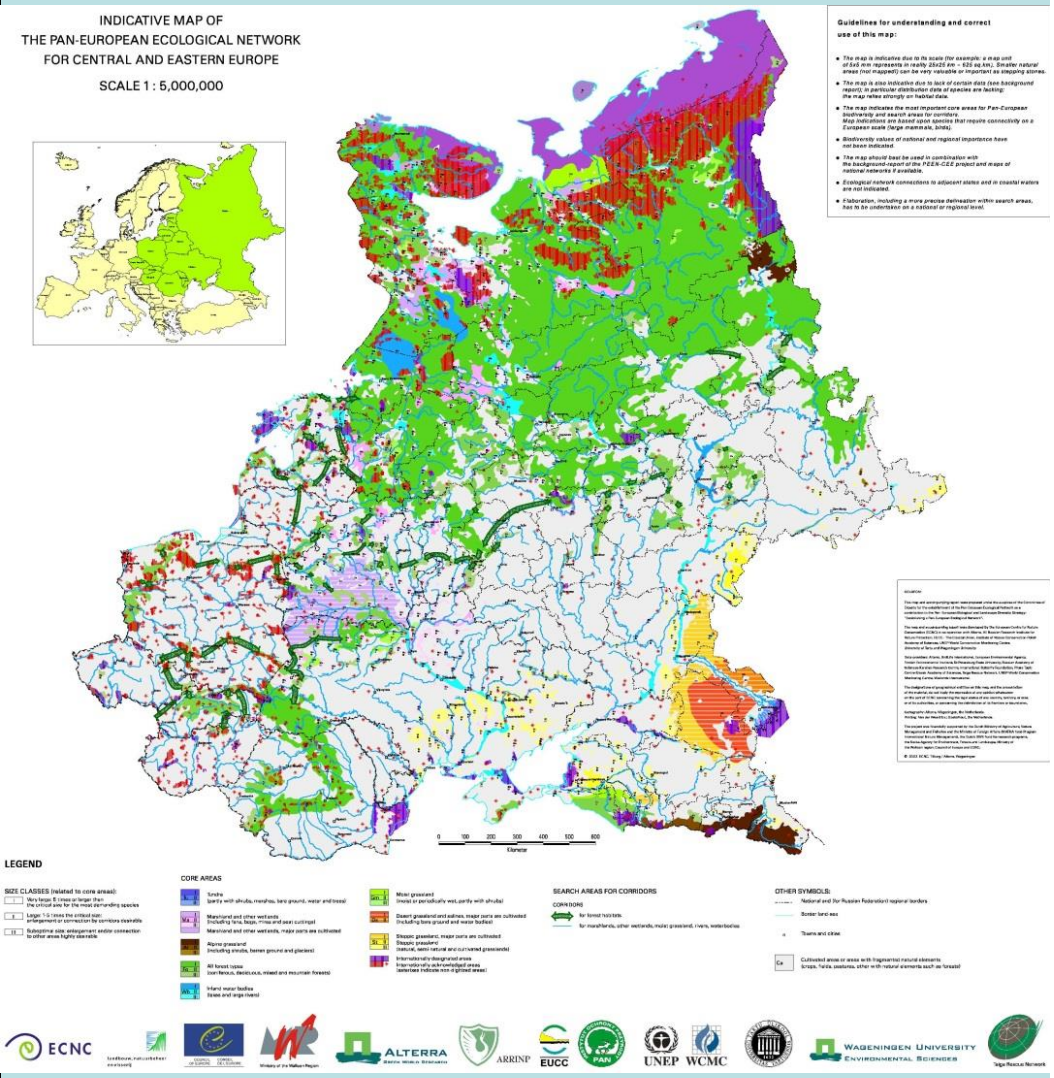
- By adopting the Pan-European Biological and Landscape Diversity Strategy in 1995, the development of ecological networks (the Pan-European Ecological Network) became the priority nature conservation on strategy in Europe.
- The Sixth Ministerial Conference "Environment for Europe" in Belgrade in 2007 represented a watershed for the development of a Pan-European Ecological Network - Green infrastructure since then.
- Developing ecological connectivity is one of the recommendations of the CBD Conference of the Parties in Nagoya in October 2010.

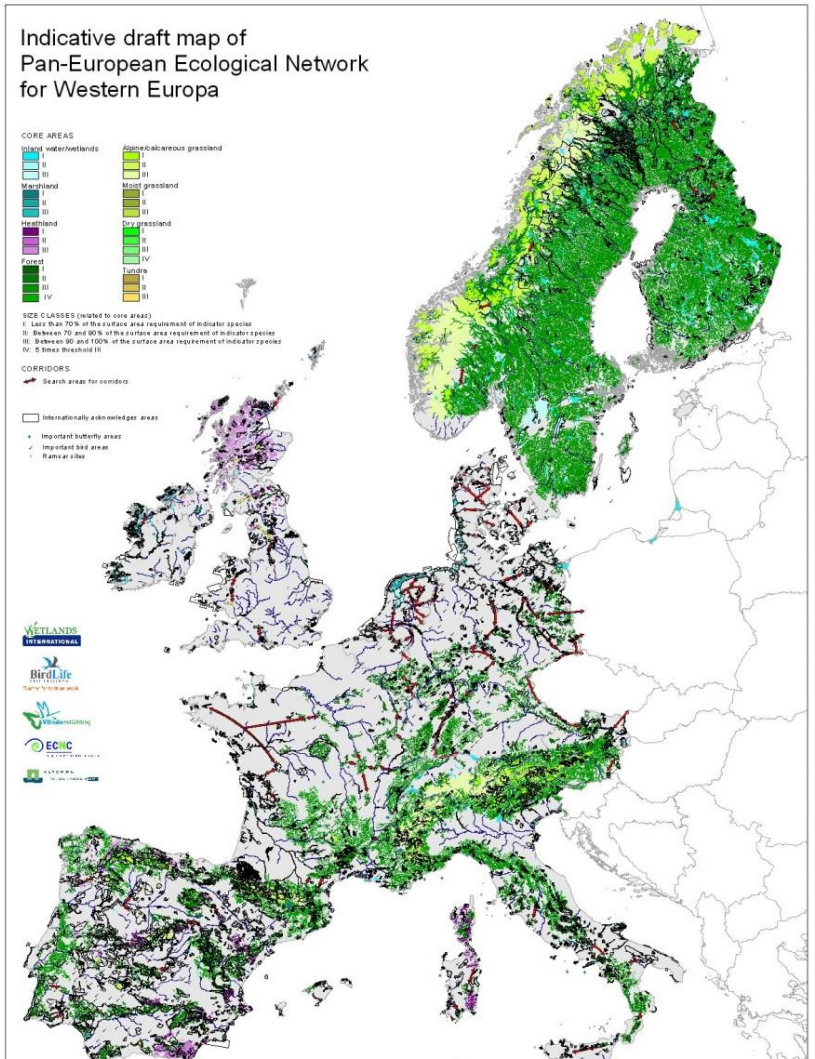
BACKGROUND: THE ECOLOGICAL NETWORKS CONCEPT

- Ecological networks' main goal is to conserve biodiversity by maintaining and strengthening the integrity of ecological and environmental processes.
- Ecological networks are based around the idea of core areas, ecological corridors, buffer zones and restoration areas.
- They are designed and managed in such a way as to preserve biological diversity and to maintain or restore ecosystem services through the interconnectivity of its physical elements within the landscape.



EUROPEAN ECOLOGICAL NETWORK





THE DUTCH NATIONAL ECOLOGICAL NETWORK

PKB - kaart 5: Ecologische Hoofdstructuur

- begrensde Ecologische Hoofdstructuur
- begrensde Ecologische Hoofdstructuur grote wateren
- zoekgebied Ecologische Hoofdstructuur
- intensief gebruikte militaire terreinen (buiten de EHS)

- begrensde Ecologische Hoofdstructuur Noordzee

- robuuste verbinding
- indicatieve robuuste verbinding (poort)
- nader uit te werken en bestuurlijk af te stemmen robuuste verbinding

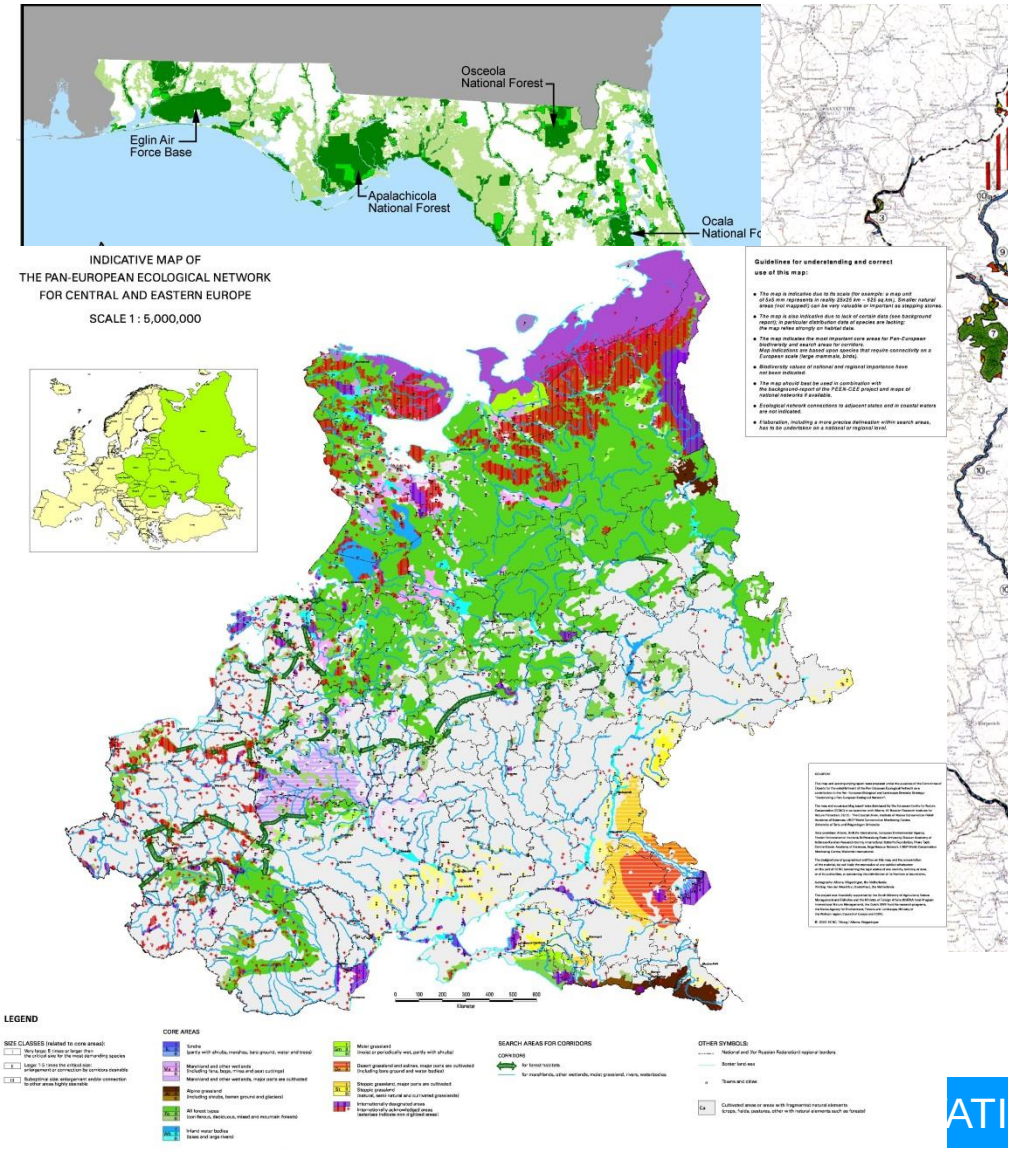
ondergrond

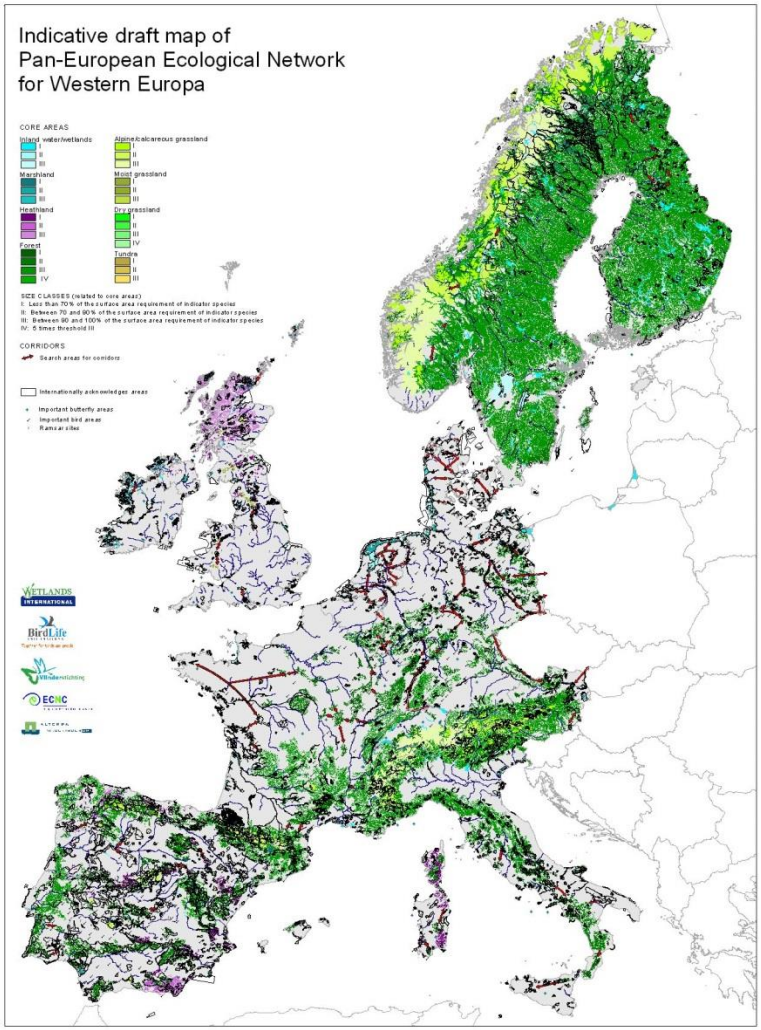
- vereenvoudigde topografie (exclusief hoofdinfrastructuur)
- grens Exclusieve Economische Zone (EEZ) en 12-mijlszone

(1:1.500.000)

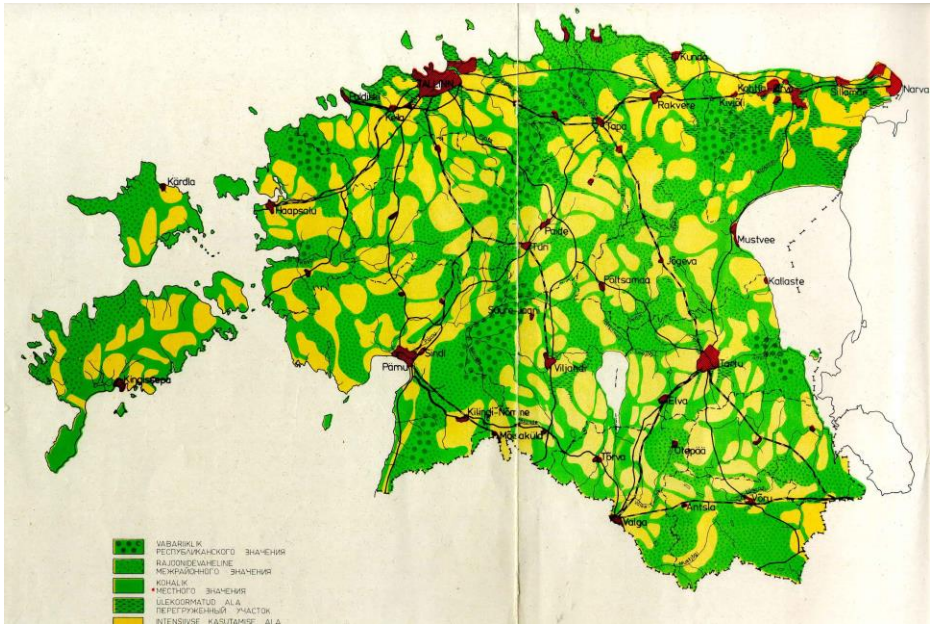
0 15 30 60 90 120 km

BUT ALSO IN FLORIDA, GERMANY AND MANY MORE





SPATIAL PLANNING, 1983, NETWORK OF COMPENSATING AREAS AT SCALE 1: 200 000



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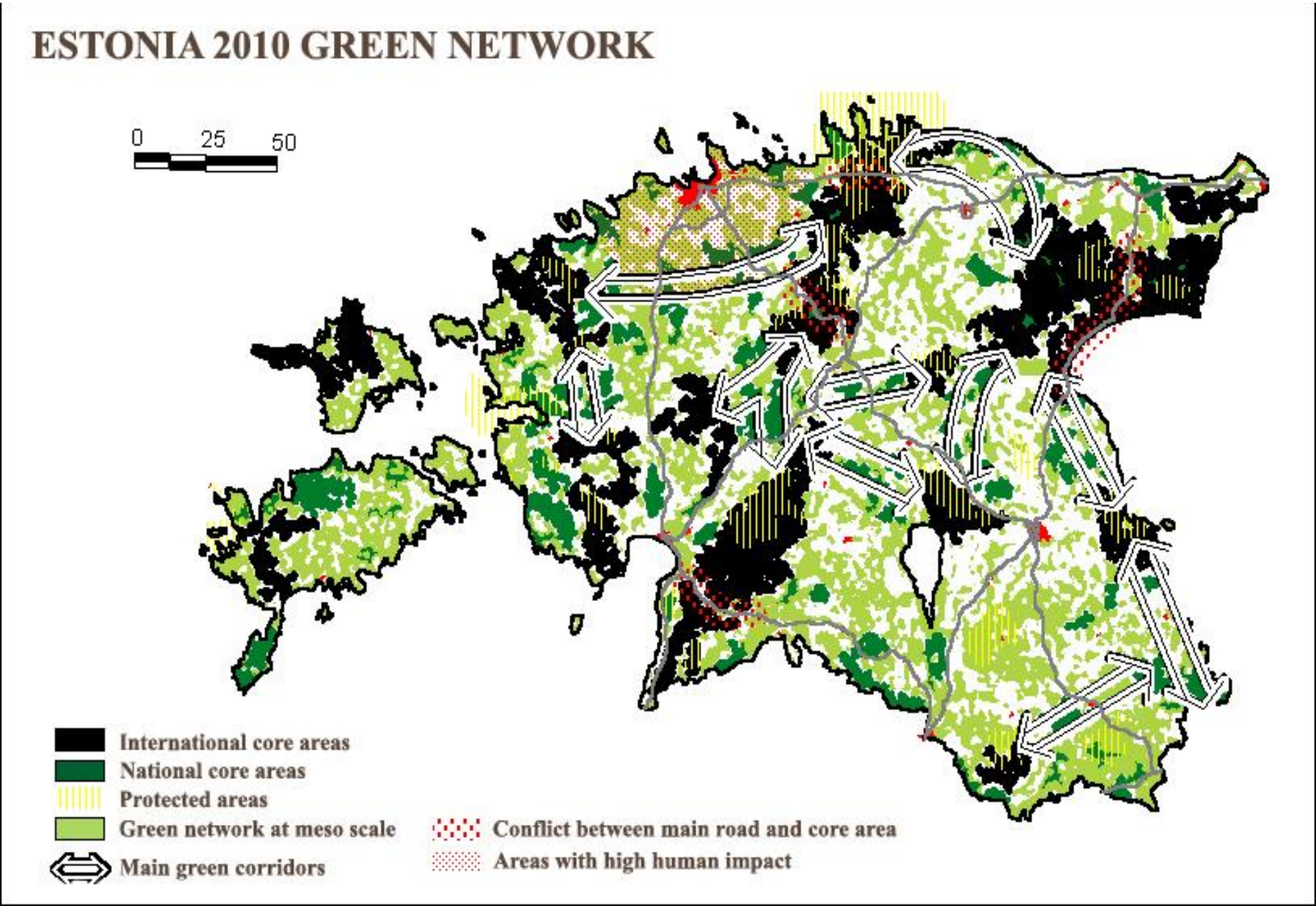
GREEN NETWORK IN ESTONIA

- Since the mid of 1990s we have a legislative and political support for ecological network applications (Act on Building and Planning, 1995, Act on Planning, 2002).
  - State level
  - County level
  - Municipality level
- The long-term National spatial strategy "Estonia – Vision 2010" included the "Green Network" chapter and also Vision 2030 will include themes related to Green Infrastructure.

ESTONIAN "GREEN NETWORK" ACCORDING TO "ESTONIA - VISION 2010



LEGISLATION AND ADMINISTRATION

- The Governmental decree for second phase of county planning (1999-2004) “Defining environmental conditions for the development of land-use and settlement structure”.
    - Green Network
    - Valuable cultural and historical landscapes
- Responsible unit was: Department of Strategy and Planning, MoE, then MoI, and now MoFinance.
- We have a detailed methodology for defining green network at county level (Jagomägi, Sepp 2002).

PURPOSES OF DESIGNING OF GREEN NETWORK

- The objective of planning the green network on the county level is not to define a large-scale 'green surface' and leave it out of use, but, first and foremost, to guarantee the naturally, environmentally, socio-economically grounded space structure, based on the location of different infrastructures and needs analysis of society.
- To complete functionality of the network of protected areas, connecting them into a complete system with natural areas.

THE FOLLOWING MAIN PURPOSES WERE STATED

- To shape the spatial structure of natural areas in the most reasonable way considering the ecological, environmental protection, economic and social aspects.
- To complete functionally the network of protected areas, connecting them into a complete system with natural areas.
- To protect valuable natural habitats and preserve the migration routes of wild animals, and valuable landscapes.
- To soften, compensate, and forestall the anthropogenic impact on nature, to contribute to sustainable development strategy.
- To offer the possibility of nature-friendly management, living styles and recreation by ensuring spatial accessibility to natural areas.

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THE FOLLOWING MAIN PURPOSES WERE STATED

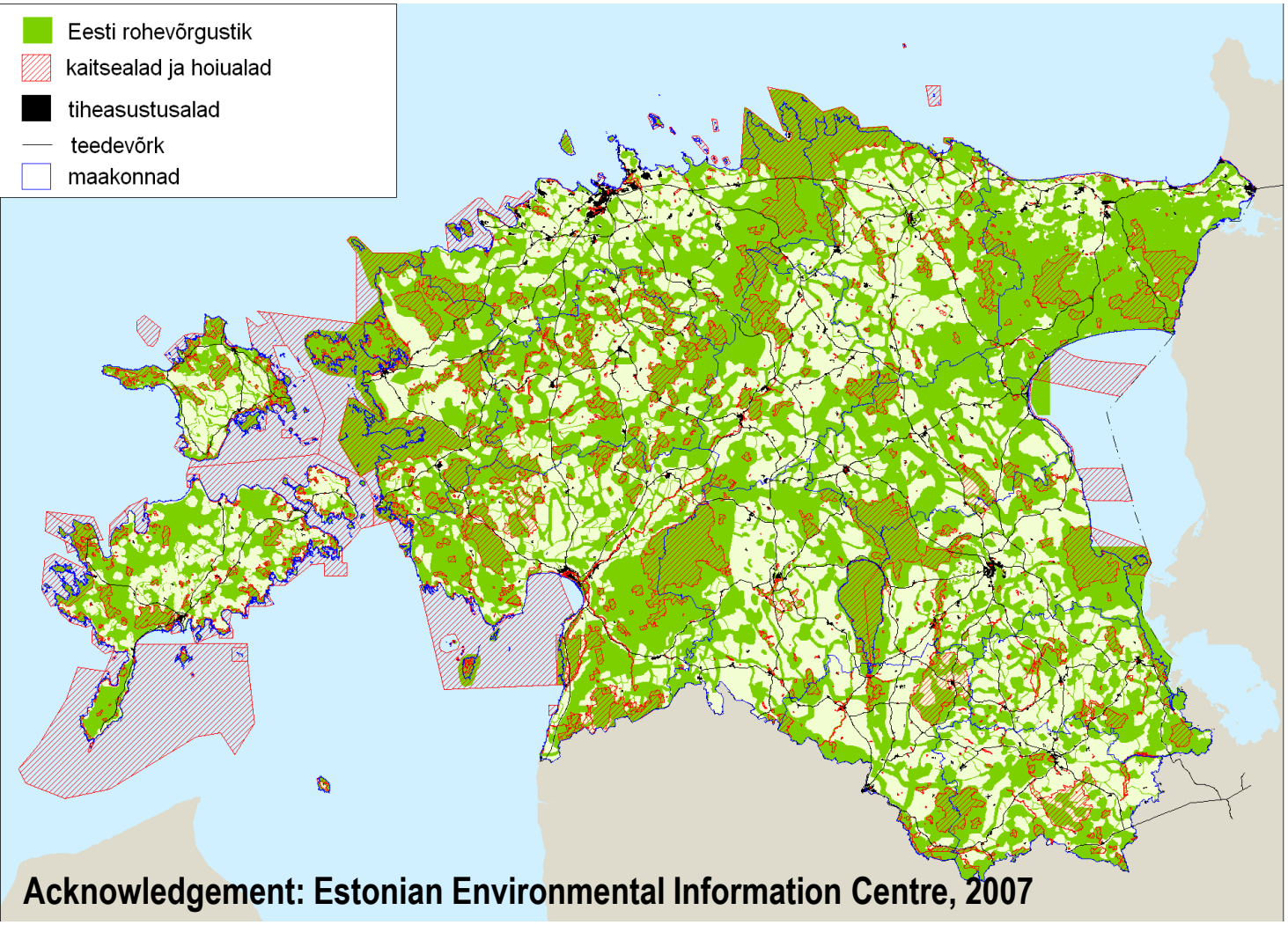
- To promote nature conservation outside protected areas.
- To minimise future conflicts of interest incorporating different sectors (forestry, agriculture, transport, recreation) through spatial planning.
- To guide development of settlement and land use structure.
- To preserve the natural self-regulation ability of the environment.
- To support international and transboundary co-operation.

METHODOLOGY

Criteria for designation structural elements

- Nature conservation and environmental protection values, threats, conflicts.
- Morphometrical parameters of the elements
  - core areas – territorial extent
  - corridors – wideness
- Ecological, environmental, socio-economic landscape peculiarities.
- Distribution of species and their habitats.

ECOLOGICAL NETWORK



Acknowledgement: Estonian Environmental Information Centre, 2007

The "legal network": ecological network compiled from 15 Green Network plans prepared at county level (2001-2007)

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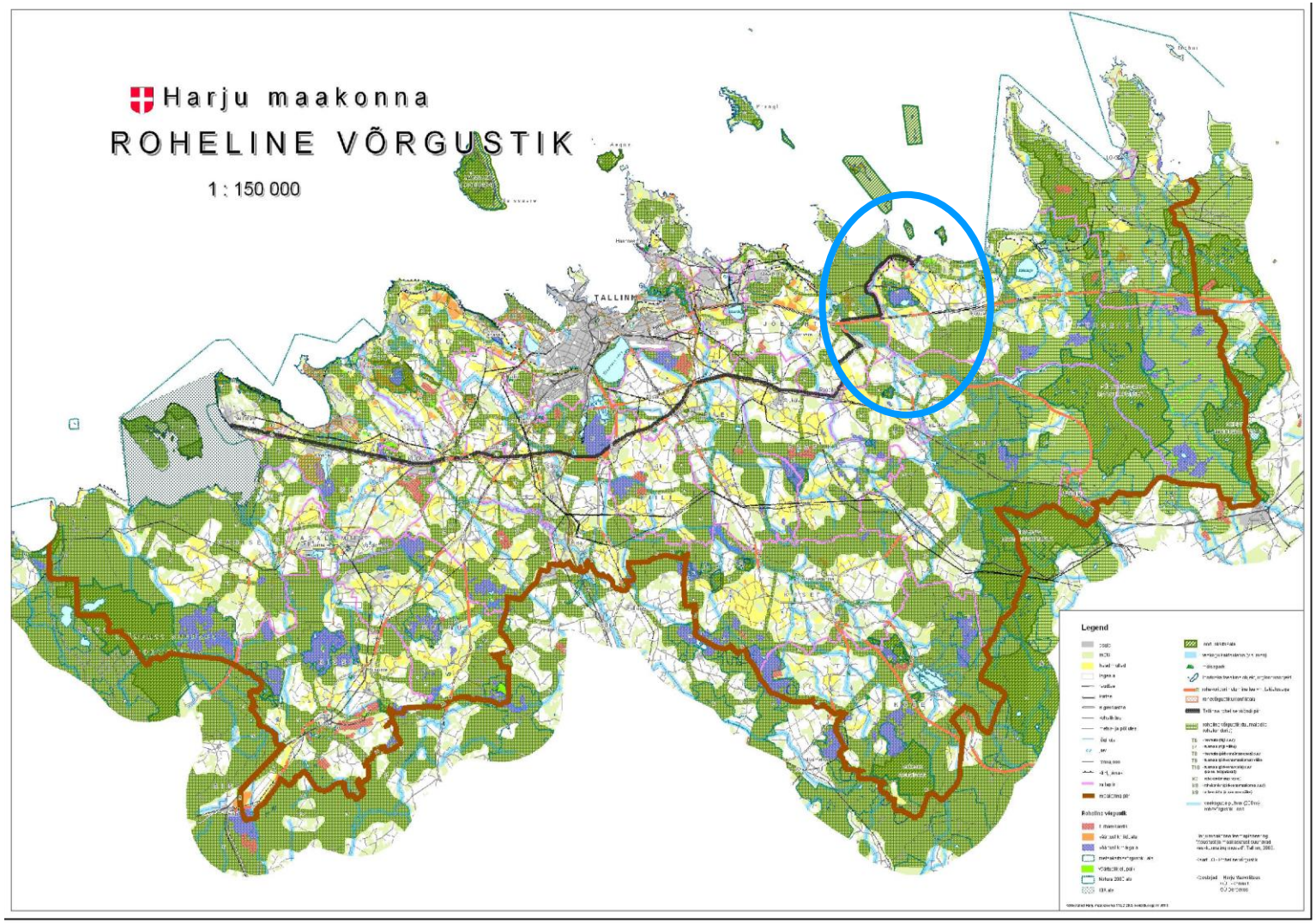
GREEN NETWORK PLAN AT COUNTY LEVEL



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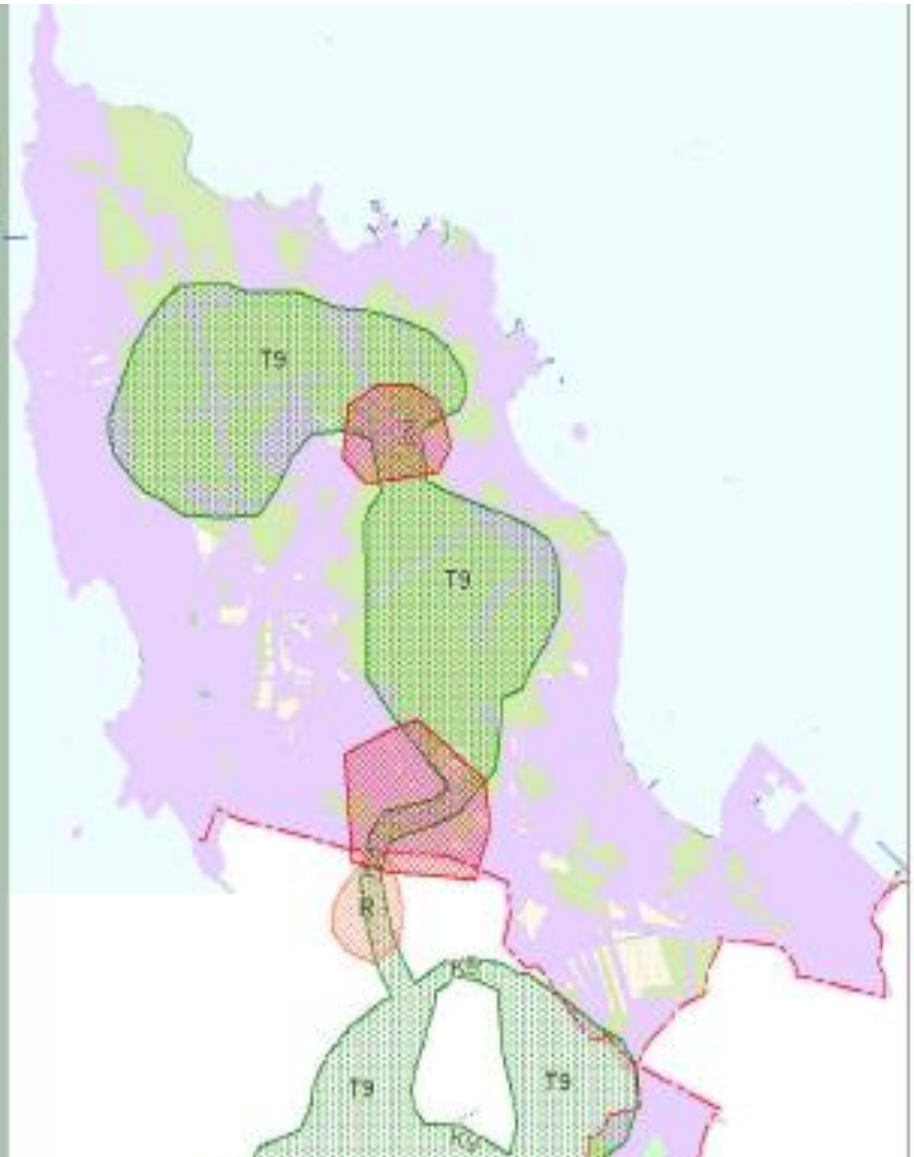
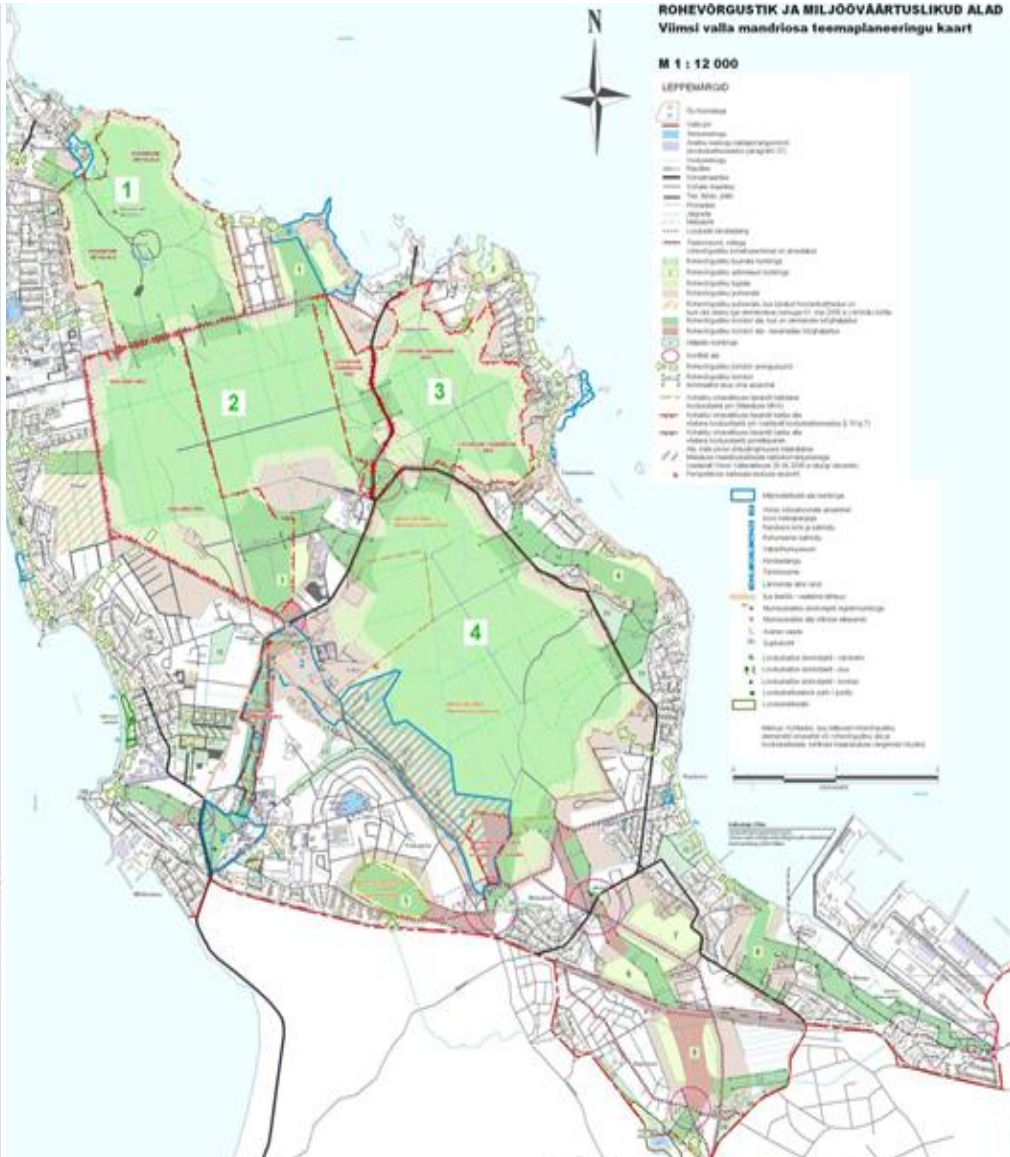
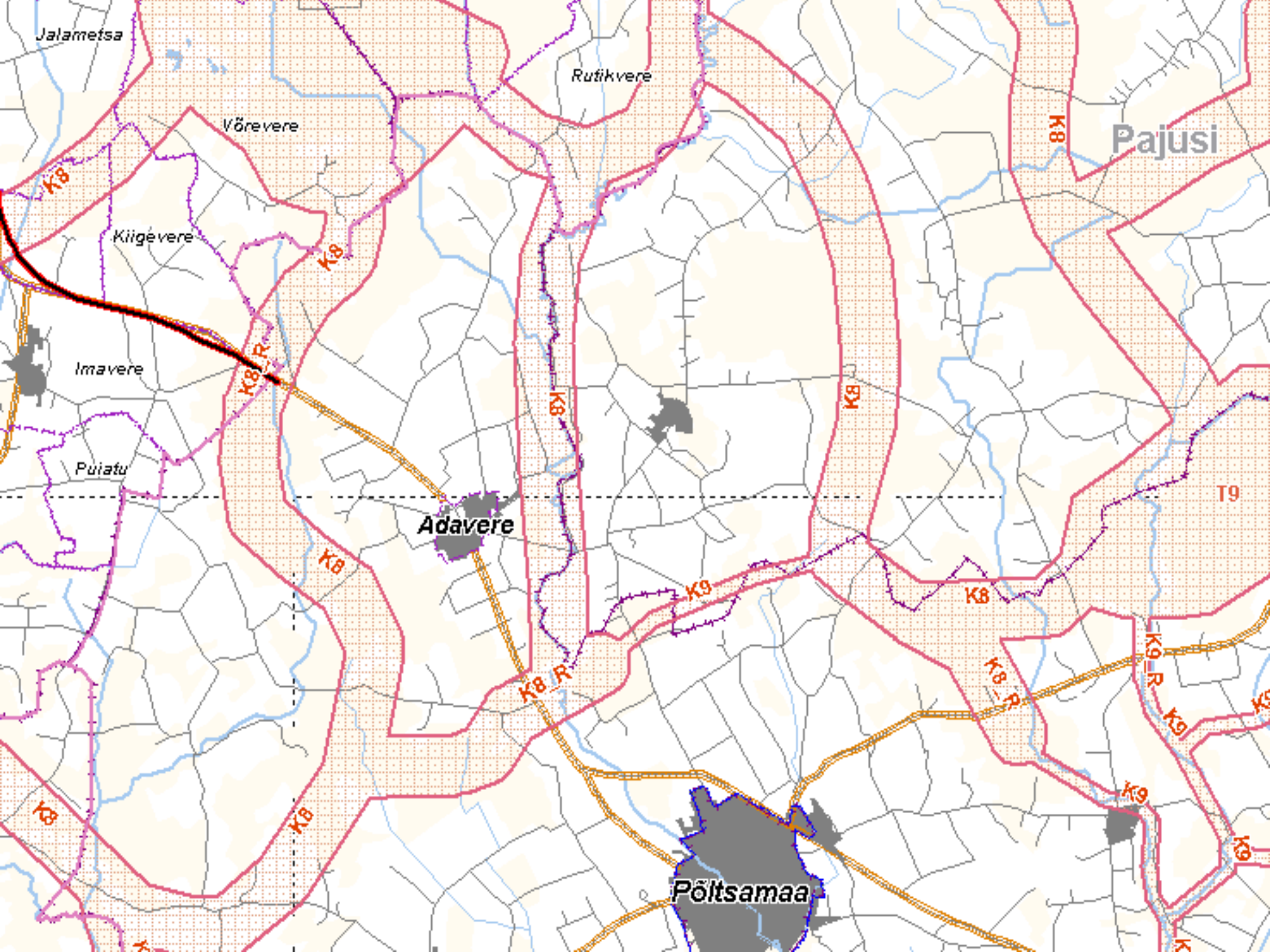
GREEN NETWORK OF "COUNTY LEVEL" SEEN FROM "COMMUNITY LEVEL"






Jalametsa
Rutikvere
Võrevere
Pajusi
Kiigevere
Imavere
Puiatu
Adavere
Põltsamaa
K8
K8_R
K9
K9_R
T9

Supporting objects of green network

Protected stones

Threatened plant species

Spring

Objects of virgin nature

sites protected under heritage

Cultural objects

Areas of water preservation

Playground of capercaille 2

Areas of virgin nature

Objects of virgin nature, buffer zone 120m

puhvriga 120m

Objects of virgin nature, buffer zone 60m

Strictly protected areas

Limited management zone

Special management zone

Corine Ibroadleaved forests

Playground of capercaille 1

Protected trees

Protected parks

RAMSAR sites

Important Bird Area (IBA)

Protected areas

Corine Biotopes

Key biotope

Valuable wetlands

Objects which preclude the green network

Pipe or line

Urban areas and settelments

Roads and railway

Basic road, buffer 50m

Basic road, buffer 300m

Peat extraction area

Peat extraction area, buffer 50m

Peat extraction area, buffer 300m

New dump sites

New dump sites, buffer 50m

New dump sites, buffer 300m

Corine dump sites

Corine dump sites, buffer 50m

Corine dump sites, buffer 300m

Corine aerodrome

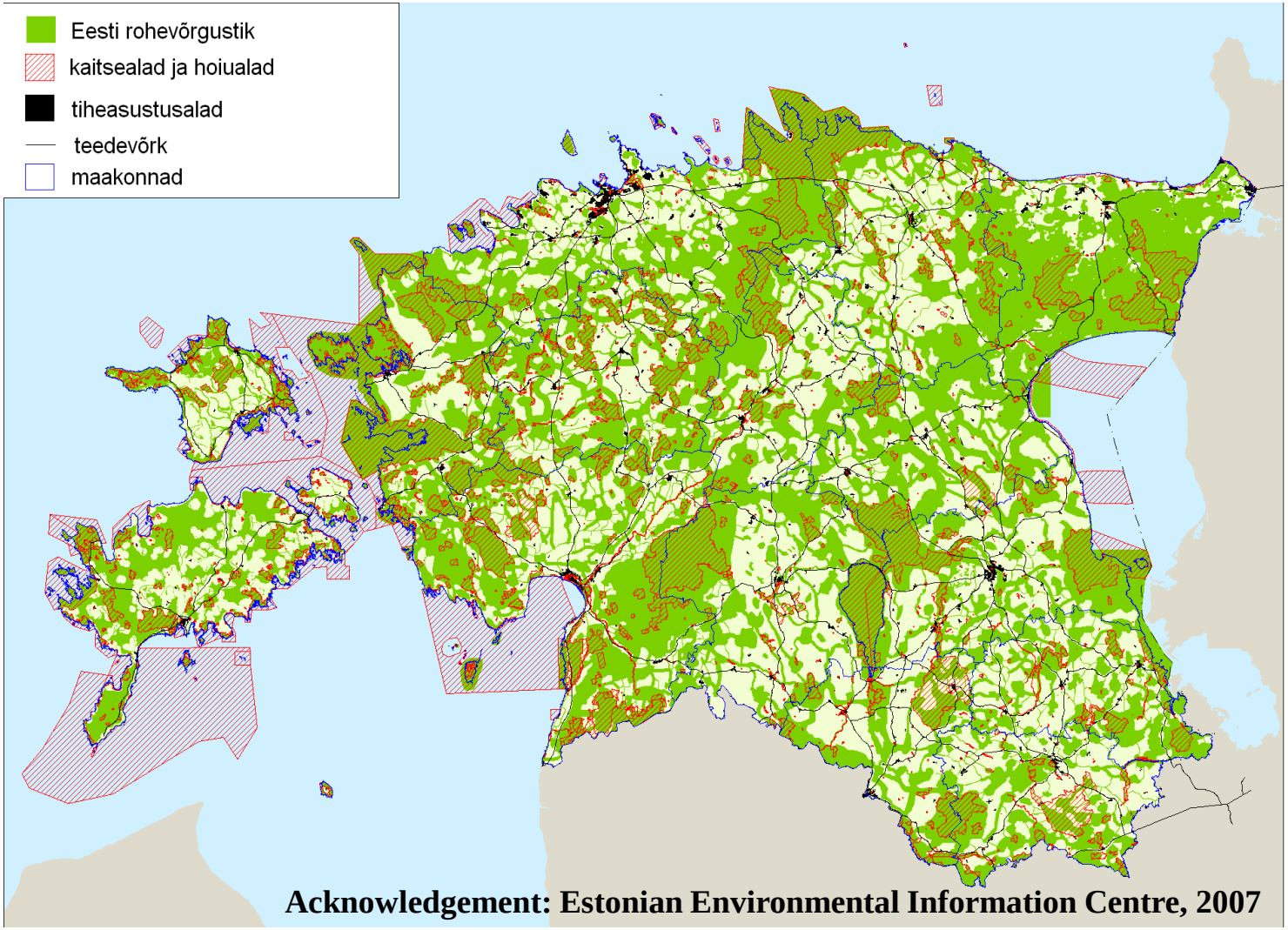
Corine aerodrome, buffer 50m

Corine aerodrome, buffer 300m

Corine opencast pit

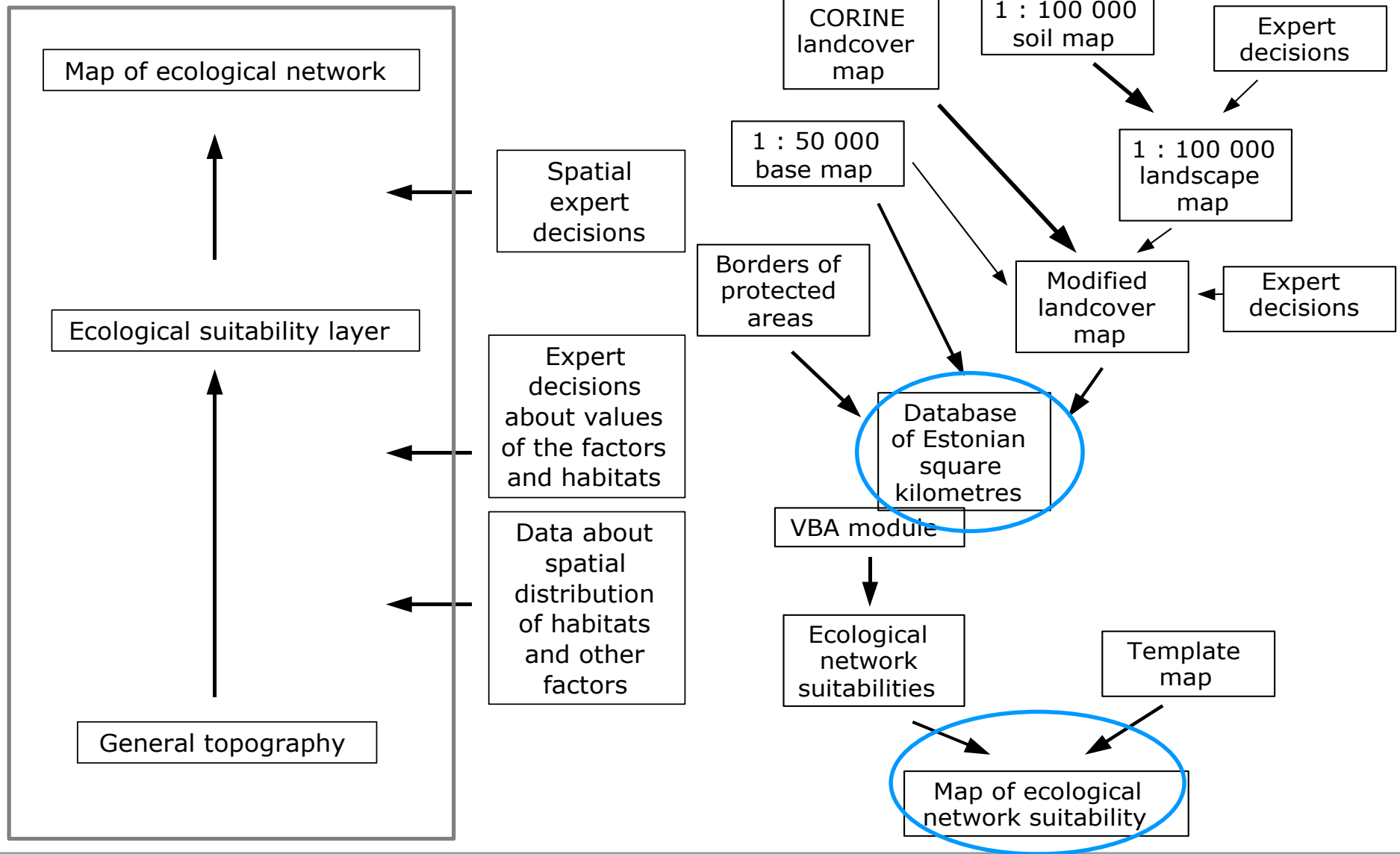
Corine opencast pit, buffer 50m

Corine opencast pit, buffer 300m



The “legal network”: ecological network compiled from 14 Green Network plans prepared at county level (2001-2007)

Principal layers of a network map (left) and source data for calculating ecological suitability layer of the map of Estonian ecological network (VBA – MicroSoft Visual Basic for Applications)



ECOLOGICAL NETWORK VALUES OF HABITATS (LANDCOVER CLASSES) IN ESTONIA

• Constructions	0.01
• Peat extraction sites	0.05
• Suburban areas	0.1
• Fields	0.2
• Complex cultivation	0.3
• Plantations	0.4
• Wooded agricultural land	0.6
• Scrubs	0.9
• Sparse vegetation	1.0
• Inland water bodies	1.2
• Coniferous forest on peat	1.3
• Heath	1.4
• Other grasslands	1.5
• Broad leaved and mixed forests on peat	1.8

• Coastal lagoons	1.9
• Coniferous forests on mineral soil	2.0
• Salt marshes	2.2
• Bogs	2.4
• Moist grasslands	2.6
• Broad-leaved and mixed forests on mineral soil	3.0
• Wooded fens and bogs	3.4
• Riparian zones	3.5
• Littoral marshes	3.6
• Fens	4.0
• Coastal dunes	4.5
• Inland dunes	5.0
• Boreal coastal meadows	6.0

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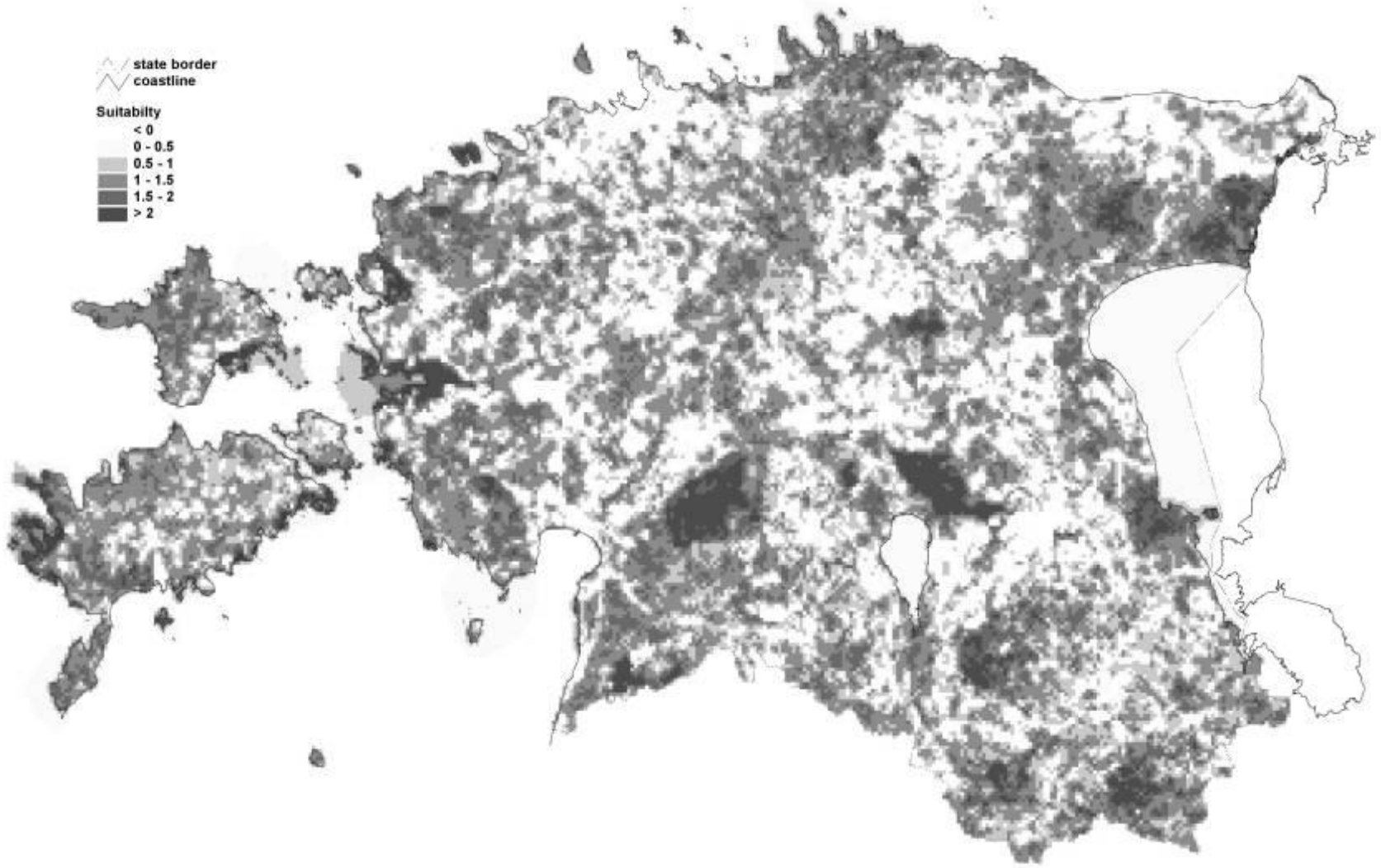
ECOLOGICAL NETWORK VALUES OF THE DENSITY OF LINEAR FEATURES

• Seacoast	1.6
• Landcover borders	1.5
• Coastline of larger [>1km^2] inland water bodies	
• (*incl.* rivers wider than 100m)	1.4
• Contour lines [recalculated to Δh=20m]	1.3
• Watercourses	1.2
• Roads	0.5

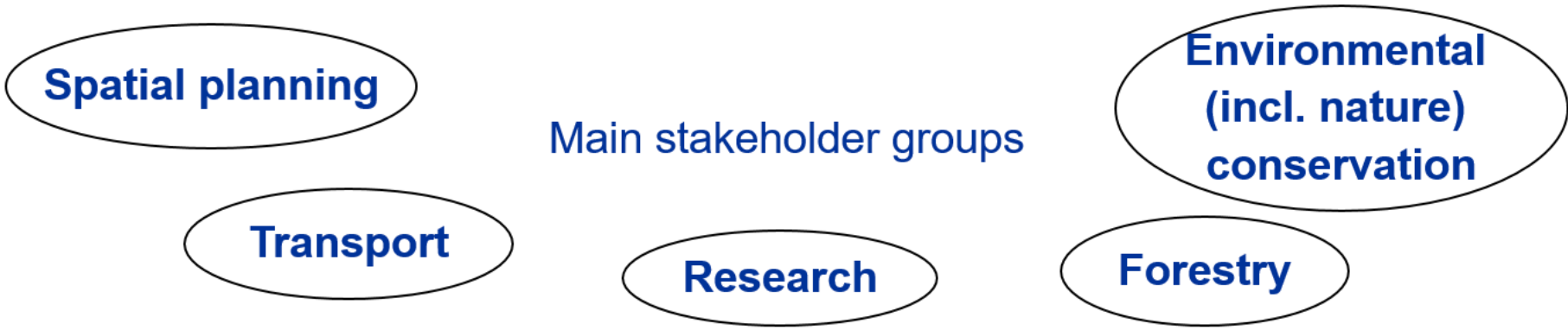
SUITABILITY AREAS FOR THE ECOLOGICAL NETWORK IN ESTONIA



SPATIAL PLANNING AT NATIONAL AND COUNTY LEVEL

- Necessary land use conditions and limitations were set on core areas and corridors (restrictions, codes of practice, environmental measures, regimes etc.).
- It is important to determine and reach agreement on the list of land use conditions which apply.

Stakeholder involvement



Their public/private affiliations:

Governmental stakeholders

- Ministry of Interior
- Ministry of Environment
- State Nature Conservation Centre
- State Forest Management Centre
- Road Administration
- and their regional departments

Business

- Spatial planning companies (representing experts of a variety of specialities)

Civil society

- Environmental NGO-s
- Resource user groups
- Landowners
- Local people

RESULTS

- All 15 counties in Estonia have defined and approved green networks at county level.
- Local authorities have started to define and several (ca 90) have approved the green network at commune level.(including towns Tallinn, Tartu, Pärnu – thematic planning)
- By 2016 the Green Network had been addressed in 87 comprehensive plans; ca 40% of municipalities

LESSONS LEARNT

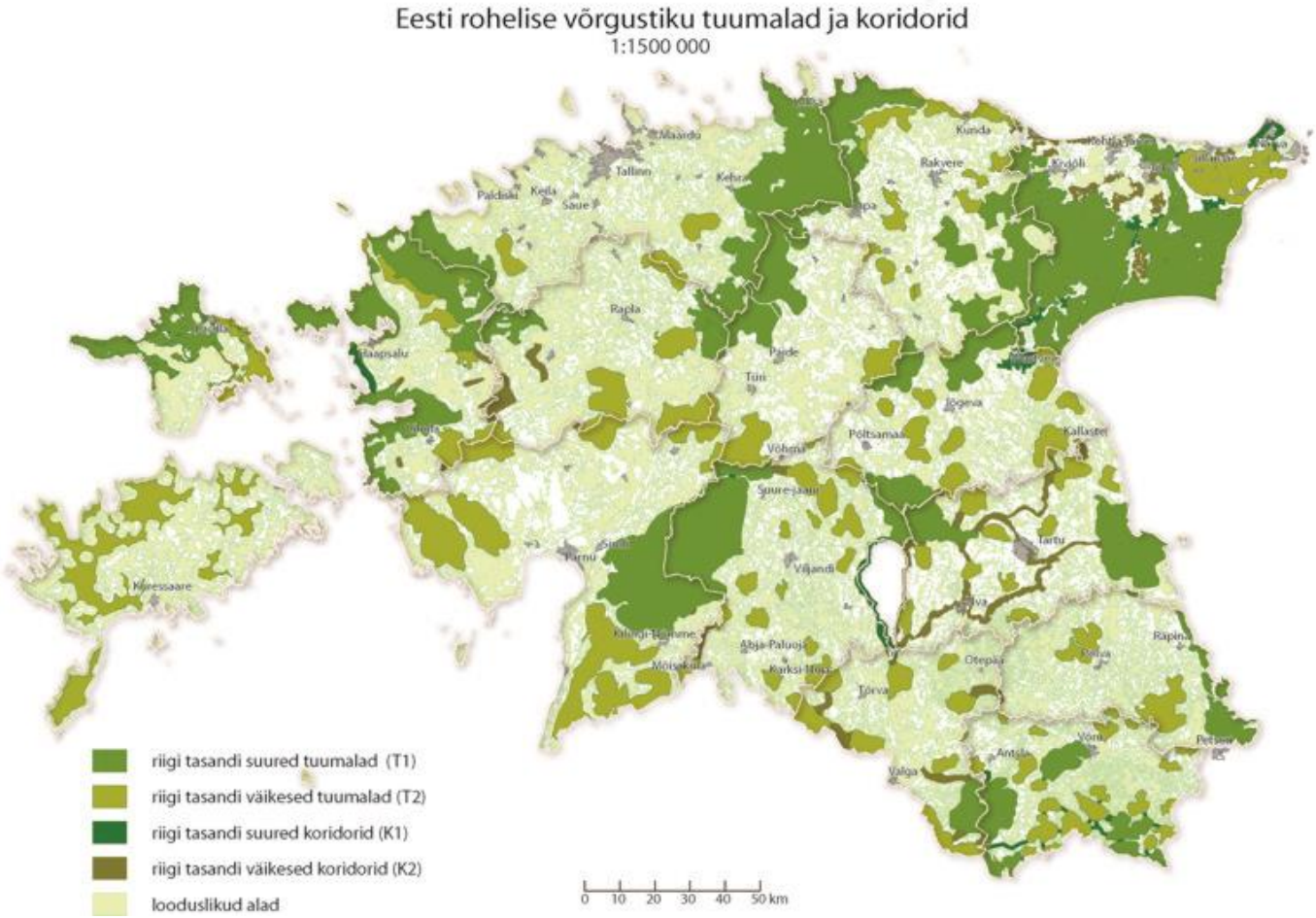
- A wide interpretation of the concept of Ecological Networks has advantages:
  - to guarantee the naturally and environmentally grounded space structure, which should guarantee sustainable development in the whole country (Ecosystem services, maintaining ecological functions at the landscape scale).
- Different sectors/stakeholders (forestry, agriculture, transport, recreation) and interest groups, including local inhabitants are involved through spatial planning.
- Implementation mechanisms should be developed and defined in the frame of the spatial planning.
- Green and Grey Infrastructure need to be planned together – with equal priority.

LESSONS LEARNT

- The practice shows that the actual implementation of the requirements has been very different among the cases. Many implemented measures are weak. Mapism!
- We should enhance existing methodologies (municipality level) in defining green (ecological) networks.
- We need criteria for evaluating functioning of Ecological network. Monitoring!
- There is a need for practical advice on implementation and for involving stakeholders, supported by direct, open and flexible communication.

ESTONIA 2030 – GREEN INFRASRTUCTURE

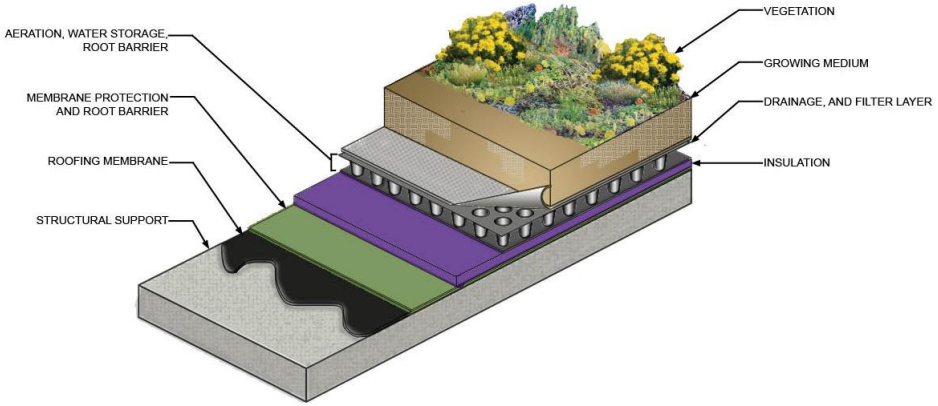
(SEPP. JAGOMÄGI 2011)



WHY A GREEN INFRASTRUCTURE?

- The Sixth Ministerial Conference "Environment for Europe" in Belgrade in 2007 represented a watershed for the development of a Pan-European Ecological Network - Green infrastructure since then.
- Loss of landscape connectivity: a new serious threat to further survival of many wildlife species.
- Changes in nature conservation approaches: Species protection >>> Habitat conservation >>> Managing the connectivity (agricultural landscape, forest, rtc)
- Multi-functionality of the Green Infrastructure: climate change, ecosystem services etc
- Greening urban planning, road constructions etc.

WHY A GREEN INFRASTRUCTURE?



In Urban areas Green infrastructure reduces….

- Flooding
- Erosion
- Stormwater runoff volume
- Stormwater pollutant loadings
- Gray infrastructure operation, maintenance, energy and treatment costs

WHAT IS GREEN INFRASTRUCTURE?

Green Infrastructure is about maintaining, strengthening and restoring ecosystems – investments that often provide multiple benefits.

It should explicitly serve the following purposes:

(1) Strengthening the **functionality** of ecosystems for continued delivery of goods and services.
This includes increasing the resilience and restoration of ecosystems and the maintenance of water and carbon cycles.

(2) Combating biodiversity loss by increasing spatial and functional **connectivity** between existing natural areas and improving landscape permeability.

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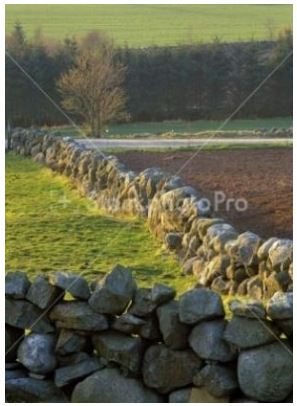
GREEN INFRASTRUCTURE COMPONENTS

a) **Healthy ecosystems** inside and outside a coherent network of protected areas (Natura 2000) with their buffer zones; such as floodplain areas, wetlands, extensive grasslands, coastal areas, natural forests etc.;

b) **Multifunctional zones** where the way land is used helps maintaining or **restoring** healthy ecosystems.

c) Natural **landscape features** such as small water courses, forest patches, hedgerows which can act as eco-corridors or stepping stones for wildlife.

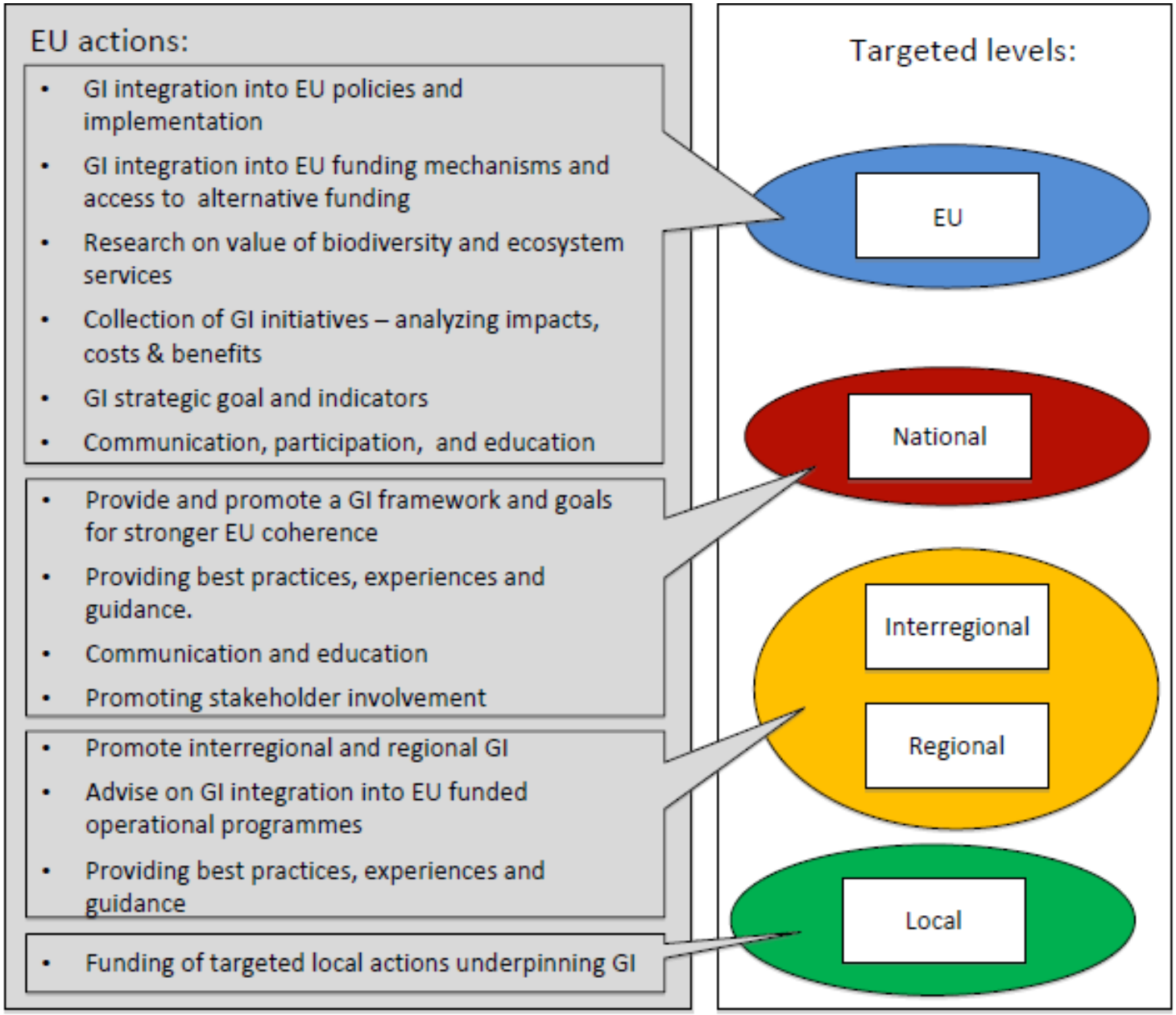


GREEN INFRASTRUCTURE COMPONENTS

e) **Artificial features** such as eco-ducts or eco-bridges, or permeable soil covers that are designed to assist species movement across insurmountable barriers (such as motorways or paved areas).

g) Areas where measures are implemented to improve the general ecological quality and **permeability** of the landscape.

h) **Urban elements** such as biodiversity-rich parks, permeable soil's cover, green walls and green roofs, hosting biodiversity and allowing for ecosystems to function and deliver their services. This should also connect urban, peri-urban and rural areas.


EU actions:
GI integration into EU policies and implementation
GI integration into EU funding mechanisms and access to alternative funding
Research on value of biodiversity and ecosystem services
Collection of GI initiatives – analyzing impacts, costs & benefits
GI strategic goal and indicators
Communication, participation, and education
Provide and promote a GI framework and goals for stronger EU coherence
Providing best practices, experiences and guidance.
Communication and education
Promoting stakeholder involvement
Promote interregional and regional GI
Advise on GI integration into EU funded operational programmes
Providing best practices, experiences and guidance
Funding of targeted local actions underpinning GI
Targeted levels:
EU
National
Interregional
Regional
Local

PRACTICAL SOLUTIONS

INTERCONNECTED NETWORK OF GI AT ALL SPATIAL SCALES

CITY GI

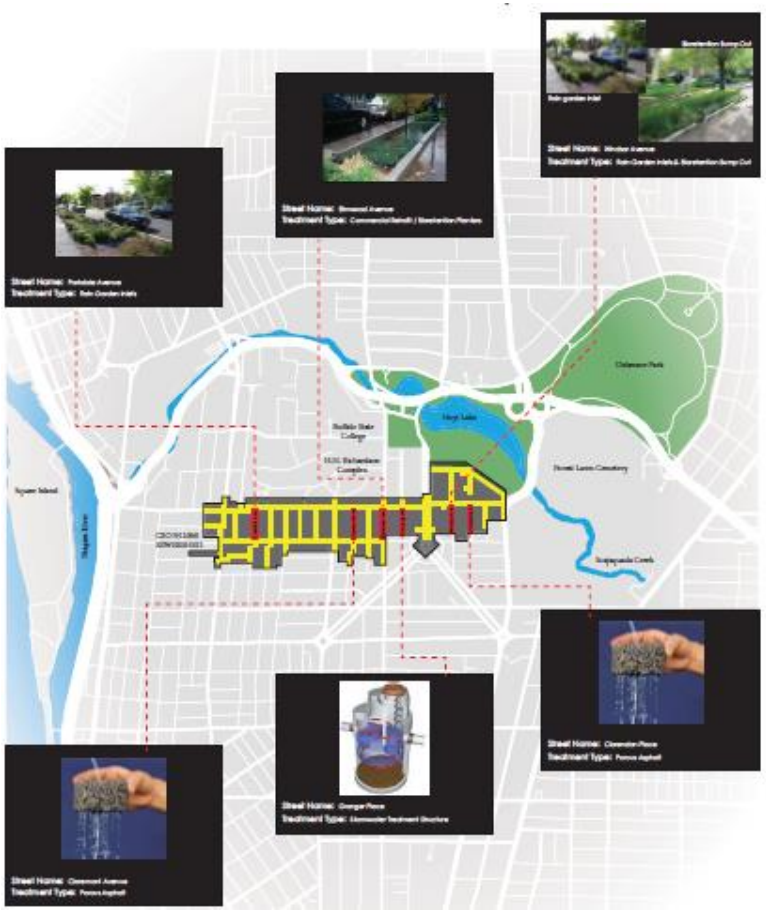
- Main Watercourses
- National Cycle Network
- Greenways
- Country Parks
- Flood Alleviation Schemes
- Major Historic Sites

LOCAL GI

- Watercourses
- Public Parks
- Pedestrian Paths and Rights of Way
- Conservation Areas
- Road and Rail Corridors/Verges

SITE GI

- Domestic Gardens
- Footpaths
- Sustainable Drainage Systems
- Trees, Hedges and Ponds
- Allotments
- Green Roofs
- Cemeteries and Churchyards



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WHAT IS GREEN INFRASTRUCTURE?

- Green Infrastructure is a strategically planned and delivered network of high-quality green spaces and other environmental features. It should be designed and managed as a multifunctional resource capable of delivering a wide range of environmental and quality of life benefit local communities.

- Green Infrastructure includes forests, rivers, coastal zones, parks, eco-corridors and other natural or semi-natural features which constitute key elements for the provision of ecosystem services.

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GREEN INFRASTRUCTURE

- Linking ecological networks to spatial planning at different geographical scales can therefore be seen as a key to effective delivery in the future.
- This is not only because of the obvious functional relationship between ecological networks and other forms of land use and infrastructure but also because delivering the concept through the vehicle of spatial planning is one of the main mechanisms for sectoral integration

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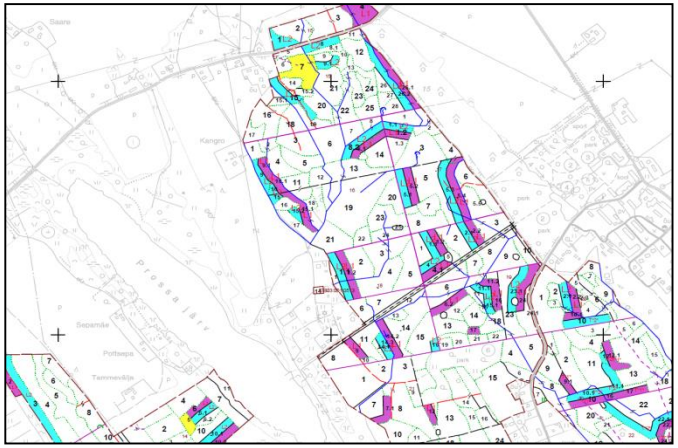
GREEN INFRASTRUCTURE

- Green Infrastructure planning should be collaborative and interdisciplinary, combining a wide range of skills and funding
- Green and Grey Infrastructure need to be planned together – with equal priority.
- Coordinated and integrated spatial planning is essential to the success of GI.

PRACTICAL SOLUTIONS

- Spatial planning
- Scales - Hierarchy
- Management measures
  - agricultural landscapes
  - forest management
  - protected areas,
  - green solutions for urban environment
  - quarries,
  - roads, rivers



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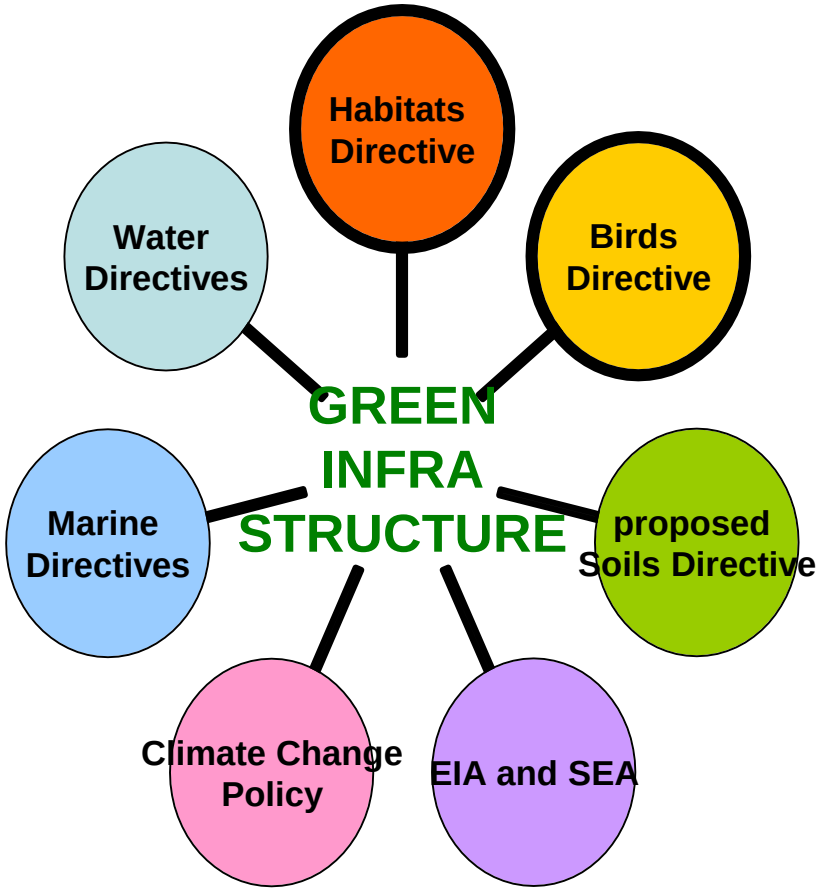
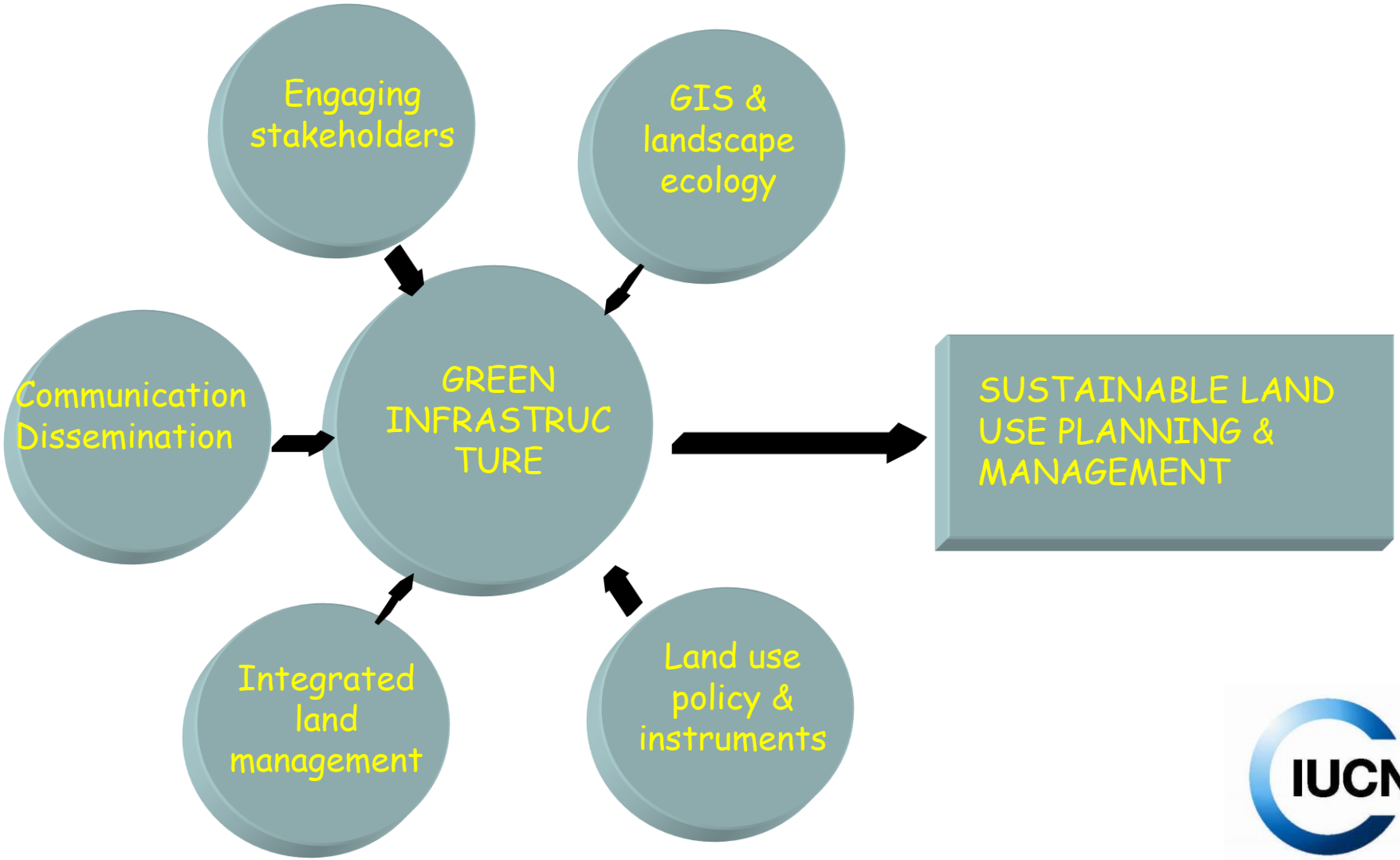
GREEN INFRASTRUCTURE

- Successful delivery of GI needs cross-sectoral integration into all relevant land-use policies is essential for sustainable development.
- GI is in the interest of a number of EU Commission Directorates.



GREENWAY AND ECOLOGICAL NETWORK PLANNING: COOPERATION BETWEEN SCIENCE, POLICY AND SOCIETY



ONGOING & FUTURE ACTIONS

- EC Communication (Green Paper), 2012 **GI Strategy.**
- Improvement of the implementation of existing **legislation**, assess new legislation possibilities, integrate approach into **funding schemes** (e.g. Regional Policy for sustainable growth in Europe 2020 COM).
- **Guidance** for Green Infrastructure implementation and financing, based on experiences ("tool box").
- Step up **research** to better understand how it works
- **Communication** to targeted stakeholders and the general public (training, citizen participation, innovative financing and capacity building).
- Promoting **integrated spatial planning** as a required tool to implement Green Infrastructure.

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CONCLUSIONS

- Land and Climate changes have a serious impact on the ecological functioning of the landscape.
- The impacts depend on the geographical position, on-going changes, characteristics of the region and the environmental conditions.
- A systematic approach looking at the whole landscape to define how the green infrastructure should be designed.
- The ecological knowledge required consists of spatio-temporal population models, quality of living environment.
- No Ecological network development without local and regional involvement and agreement, stakeholders!

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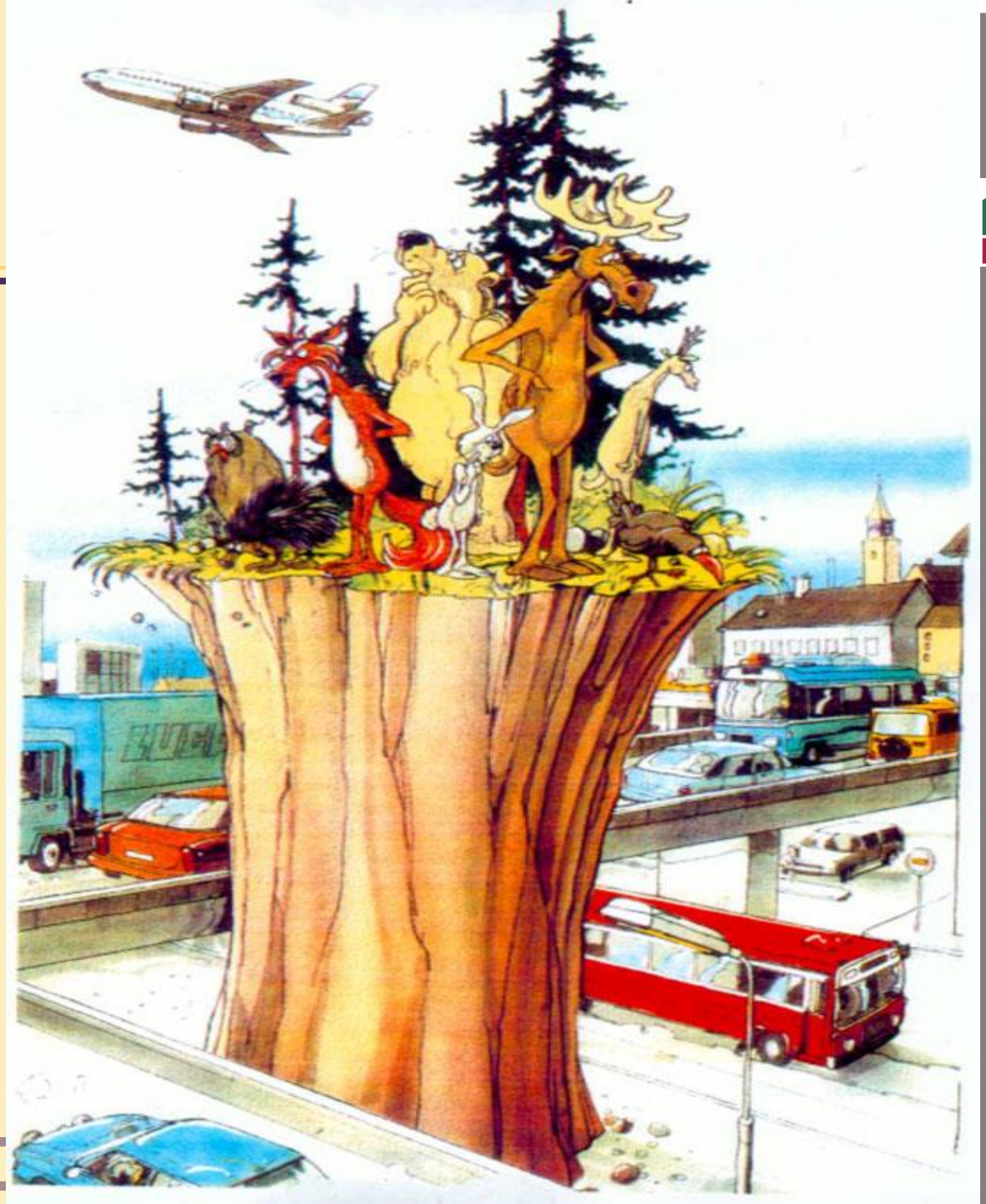

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Eesti Maaülikool

Estonian University of Life Sciences

Thank You!!

Specific Traits of Green Areas Across Urban Functions in European urban areas

Ioan Cristian Ioja

University of Bucharest, Centre for Environmental Research and Impact Studies

Twitter: @iojacristian2

Email: cristian.ioja@geo.unibuc.ro

SUNRAISE – SURE Summer School 7-14 July 2019 Salzburg, Austria

URBAN + MOUNTAINS – Sustainable Natural Resource Use in Arctic and High Mountainous Areas

Simple question...

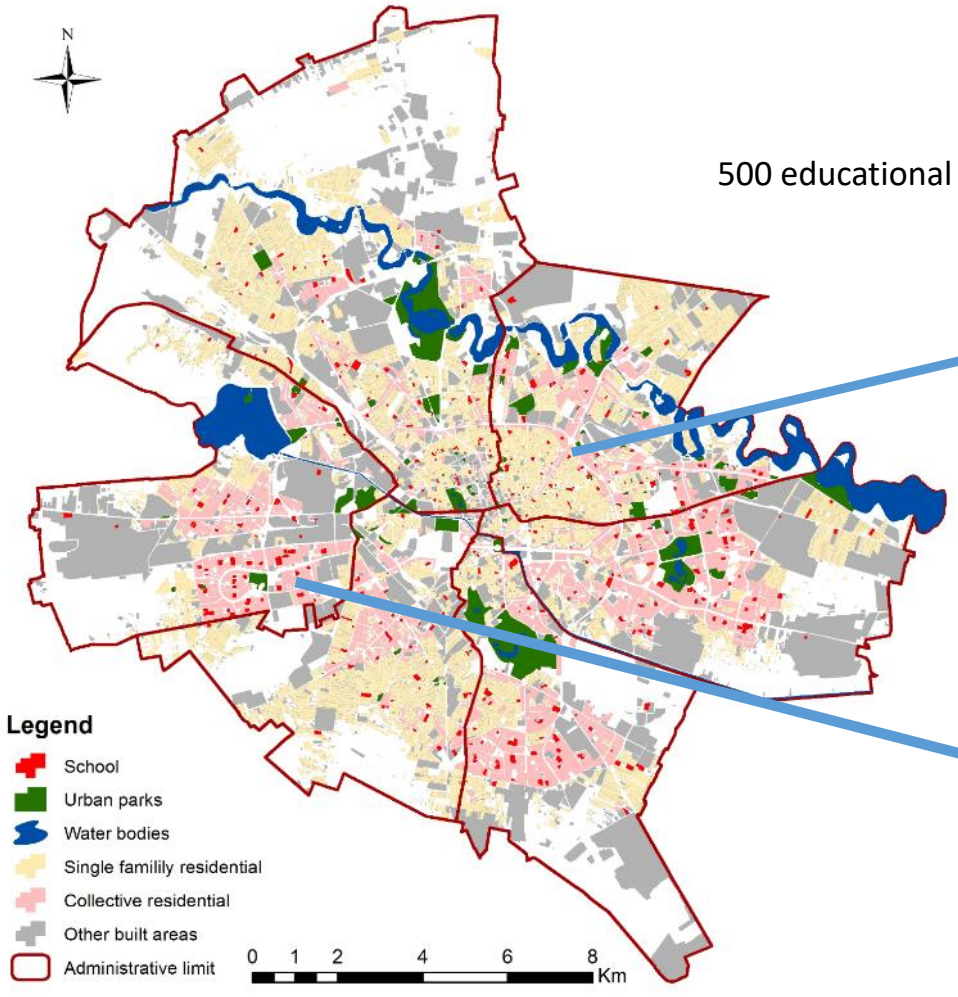
- What kind of green areas are the most important in our cities for a specific ecosystem services suppply?
  - Naturalness
  - Diversity
  - Structure
  - Surface
  - Accesibility
  - Quality
  - Connectivity
  - Functionality
  - Conservation value
  - Costs...

Diversity

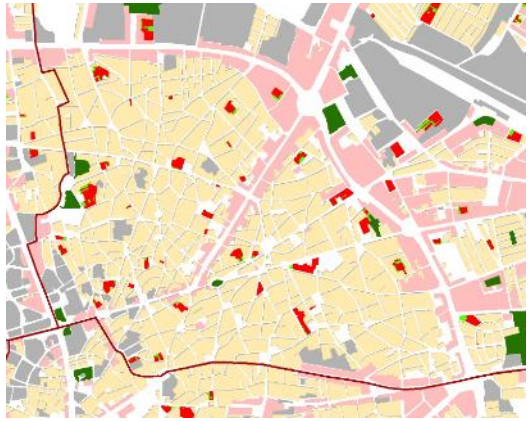
Diversity of green in urban settings

- less to completely transformed ecosystems,
- small and fragmented patches, usually strongly influenced by adjacent surroundings,
- less to high level of human maintenance,
- different level of natural processes (sometimes limited at spontaneous vegetation and natural succession),
- different ratio between native and exotic species;
- relevance for nature conservation, considering the potential to be integrated in regional urban infrastructure

Spatial distribution

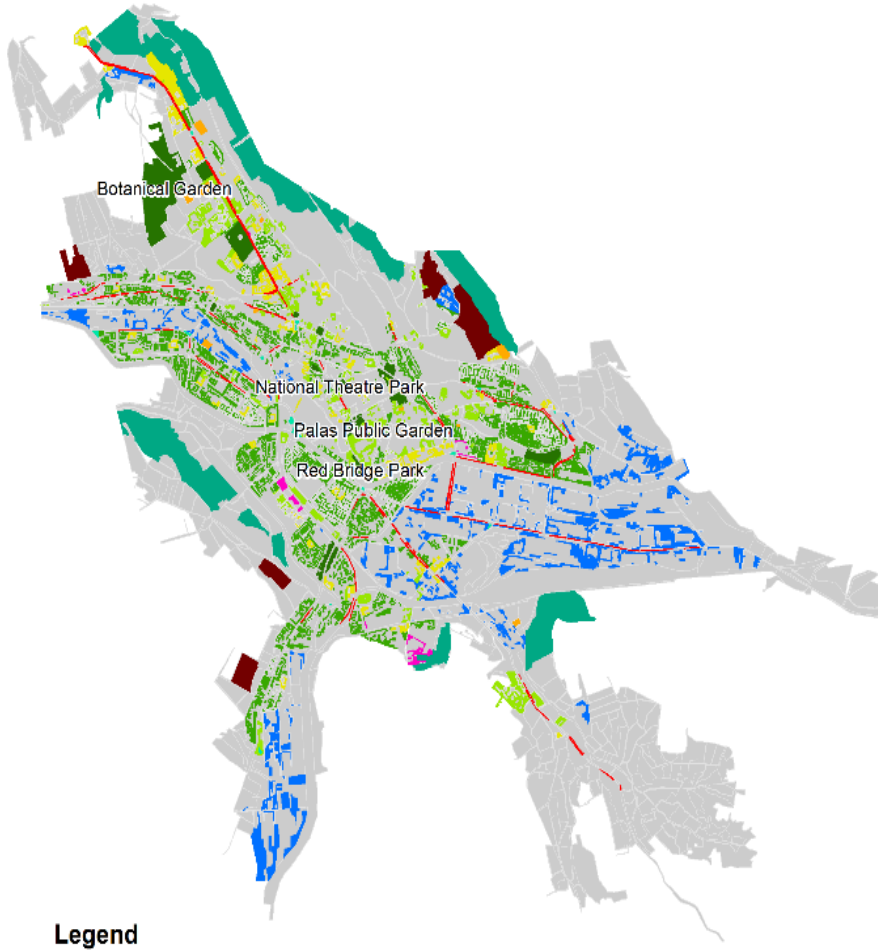


500 educational units



Structure

- Medium city - *Iasi*



Legend

UGI categories

- Street trees
- Urban parks
- Urban forests
- Residential gardens
- Public institutions' gardens
- School green areas
- Squares
- Cemeteries
- Sport fields
- Green spaces of industrial areas
- Green spaces of comercial areas
- Impermeable surfaces

1 0.5 0 1 Kilometer

- Small city - Isaccea

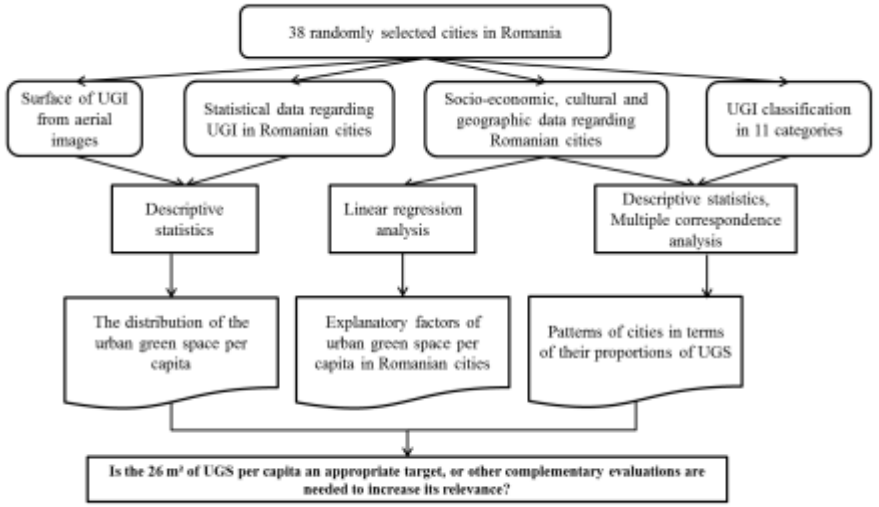
Legend

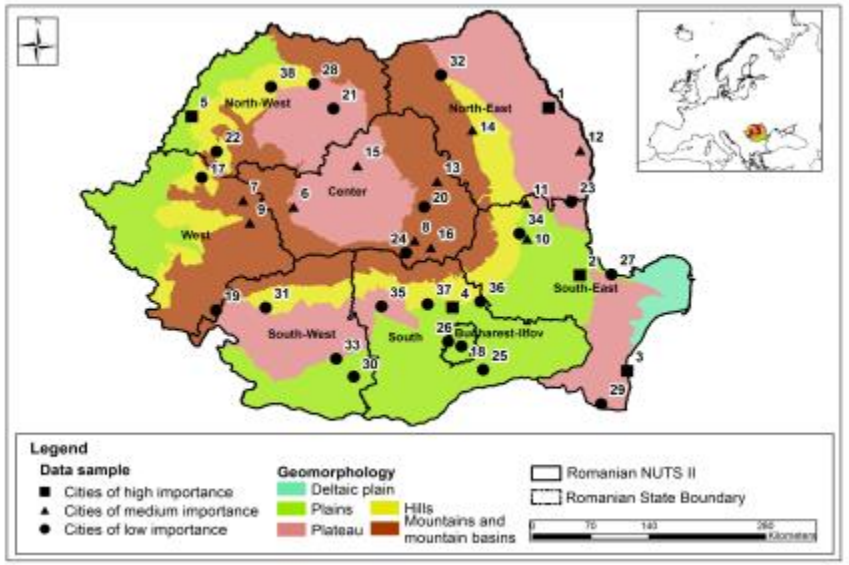
UGI categories

- Street trees
- Residential gardens
- Public institutions' gardens
- School green areas
- Green spaces of industrial areas
- Impermeable surfaces

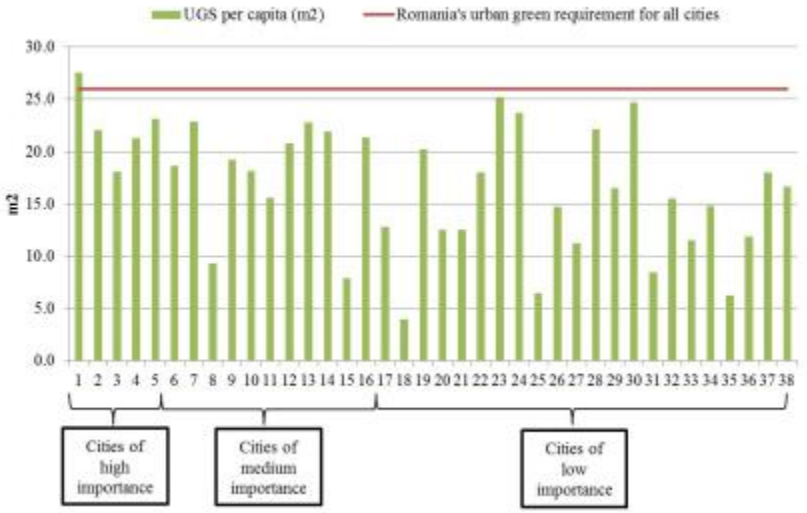
0.350.175 0 0.35 Kilometers

Green areas per capita





No.	Data source	Extraction approach/data type	Year	Urban green categories considered
1.	Aerial images	Extraction of UGS using ArcGIS 10.1	2008	Street trees, cemeteries, institutions' gardens, public residential gardens, school green area, parks, urban forests, squares, industrial green spaces, commercial green spaces, sports grounds
2.	TEMPO Database (National Institute of Statistics)	Statistical data	2008	The surface of green spaces in cities - parks, institutions' gardens, residential gardens, squares, sports grounds
3.	Environmental Protection Agencies	Statistical data	2008	All green categories as a whole
4.	Urban Atlas	Urban green surface	2010	Green urban areas, sports and leisure facilities



Traits

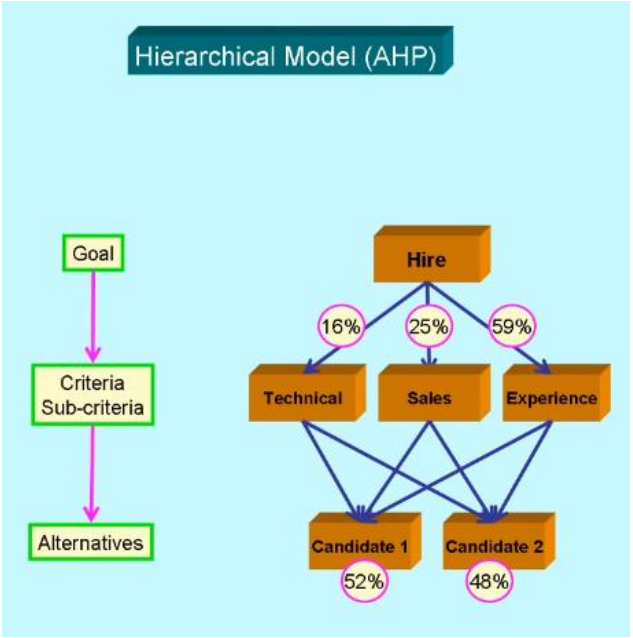
Traits	Urban parks	Urban forests	Street trees	Community Garden	Commercial green	Sport facilities	Schools green	Elderly facilities
Surface	Medium	Large	Small	Small	Small	Large	Small	Small
No. of People	Large	Small	Large	Small	Large	Small	Small	Small
General access	Open	Open	Open	Partial	Partial	Partial	Restricted	Restricted
Attractivity	Large	Medium	Medium	Reduced	Medium	Reduced	Reduced	Reduced
Accessibility	High	Medium	High	Reduced	High	Medium	Medium	Reduced
Endowments	High	Low	Medium	Medium	Medium	Medium	Low	Low
Functional areas	Mixt	Periphery	Mixt	Periphery	Mixt	Mixt	Residential	Periphery

How to choose relevant criteria?

- What is the research question?
- What is relevant to answer to the question and to do the hierachy/clasification?
- Past researches.
- Accesibility of information and their accuracy
- CRITERIA – RELEVANT IF WE WANT TO TAKE A DECISSION AND WE HAVE MULTIPLE OPTION.
- ……

Analitical Hierarchical Model

- Created by Thomas Saaty
- The main step:
  - Identify the alternative and of relevant criteria
  - Built the matrix, comparing the criteria between them, using a preferency system
  - Determining the criteria weight
  - Criteria and Alternative Hierarchy
  - Establishing the global priority (e.g. The best alternative)



Built the matrix

- Criteria A
- Criteria B
- Criteria C

Criteria A is 9 times more important that C, and of 7 times less important as B

Criteria	A	B	C
A	1	1/7	9
B	7	1	1/8
C	1/9	8	1

Preferences	**Value**
Both are of the same importance or preference	1
One of the criteria is moderately more important than another (poor preference)	3
Strong preference for one criterion relative to another	5
There is a very strong preference for one criterion relative to another	7
One criterion is clearly preferred over others	9
Intermediate value	2-4-6-8

Determining the criteria weight

	Product of the value from the line 1	The result	Third root of Column 3	Column divided to SUM of column 3 (3,0052) = criteria weight
	Column 1	Column 2	Column 3	Column 4
Criteria 1	1 x 1/7 x 9	1,2857	*1,0873*/3, 0052	0,3618
Criteria 2	7 x 1 x 1/8	0,875	0,9564/3, 0052	0,3183
Criteria 3	1/9 x 8 x 1	0,8888	0,9615/3, 0052	0,3199
		SUM of Column 3	**3,0052**	


SUPER
DECISIONS
CDF

Initial input for our model

- **Question**: What is the most important green areas for food provision in urban settings?
- **Alternatives**: community garden, allotment gardens, individual private garden
- **Criteria**: Choose **three relevant criteria** in your team to answer to the research questions (5 minutes)

Alternative description

- A community garden is a **single piece of land** gardened **collectively** by a group of people.
- An allotment garden is a plot of land made available for **individual**, **non-commercial gardening or growing food plants**. Such plots are formed by subdividing a piece of land into a few or up to several hundred land parcels that are assigned to individuals or families.
- A **private individual garden** is a single piece of land, gardened individualy by a private landowner for commercial or non-commercial gardening.

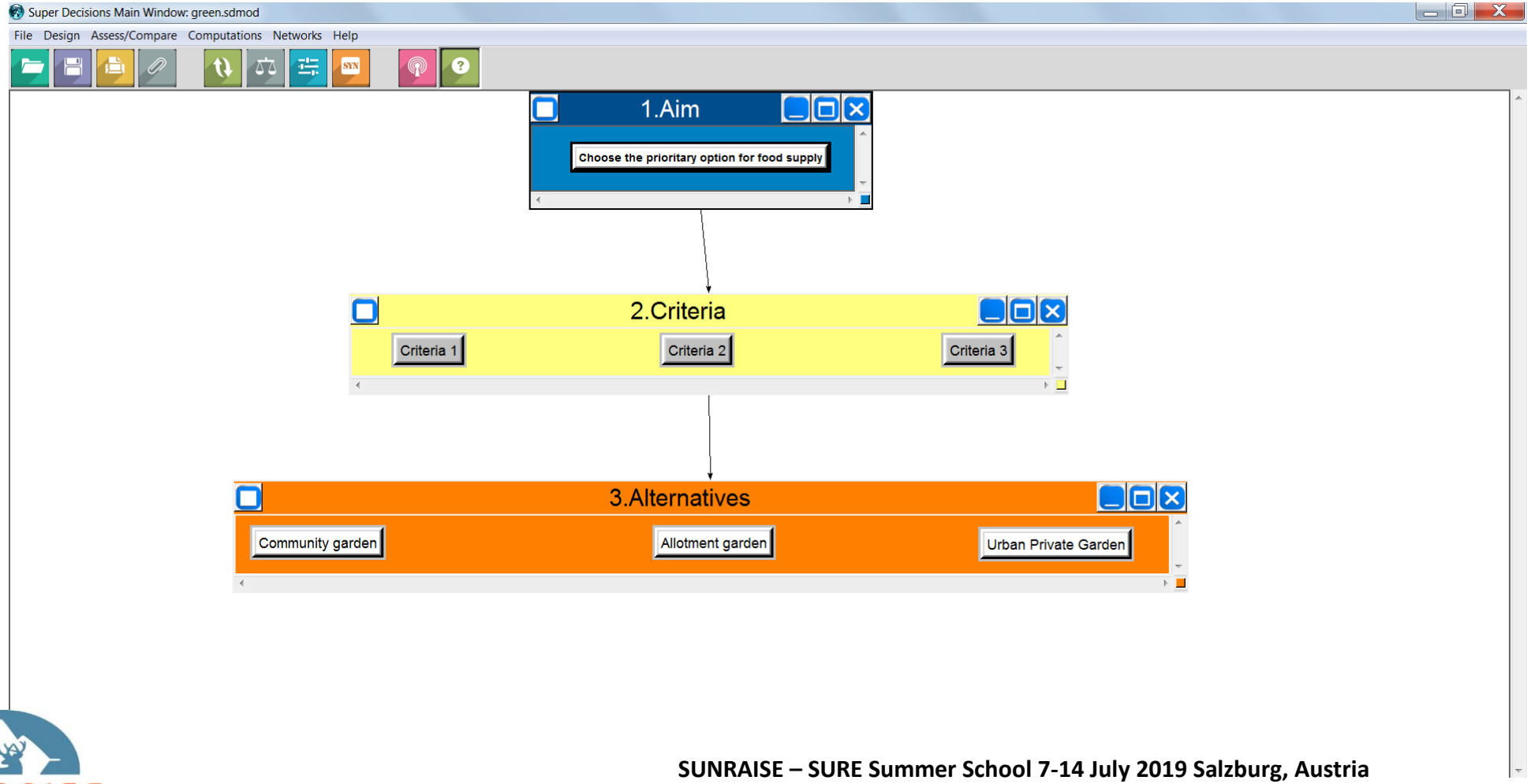
Cc

Main Menu Commands

- File - New - brings up templates, Open file, Close file, Recent Files, Backups, Import model in .txt format, Export supermatrices to .txt files, Print model report, Old files have *.mod* extensions, new files have *.sdmod* extensions
- Design - Build a network by creating clusters and nodes and making node connections
- Assess/Compare - Perform pairwise comparisons, access the Ratings spreadsheet if there is one
- Computations - Synthesize results, look at supermatrices, perform sensitivity, do sanity check for errors and incomplete comparisons
- Network - quickly transit around the sub-networks in a complex model and go going directly into a selected subnet
- Test - Programmer menu for development work
- Help - Sample models, including some in other languages, Help, for now use this old Help file: http://www.superdecisions.com/SuperDecisions_Help.pdf

Built the model

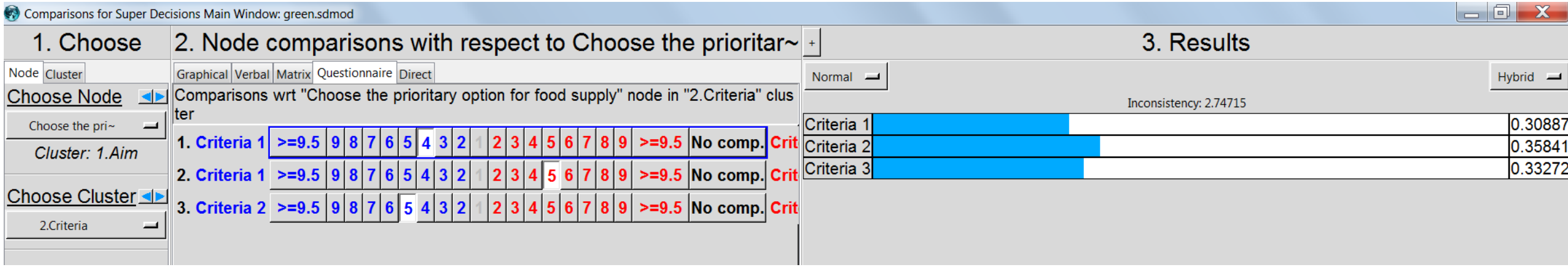
- 1. New cluster (1.Aim; 2. Criteria, 3. Alternative) – Design/Cluster/New
- 2. New node (each cluster need to have minimum 1 node) – Design/Node/New inside of each Cluster
  - 1 Aim – the research question
  - 2 Criteria – the relevant criteria
  - 3 Alternatives – the alternatives
- 3. Realise the connection between the nodes (Design/Node connection)
  - Realising the connection between 1 Aim node and each criteria nodes
  - Realising the connection between each criteria nodes and alternative nodes


Super Decisions Main Window: green.sdmod
File Design Assess/Compare Computations Networks Help
1.Aim
Choose the prioritary option for food supply
2.Criteria
Criteria 1
Criteria 2
Criteria 3
3.Alternatives
Community garden
Allotment garden
Urban Private Garden

Comparision of criteria

- 1. Compare the criteria between them considering the research question (Assess/Compare/Pairwise comparision)

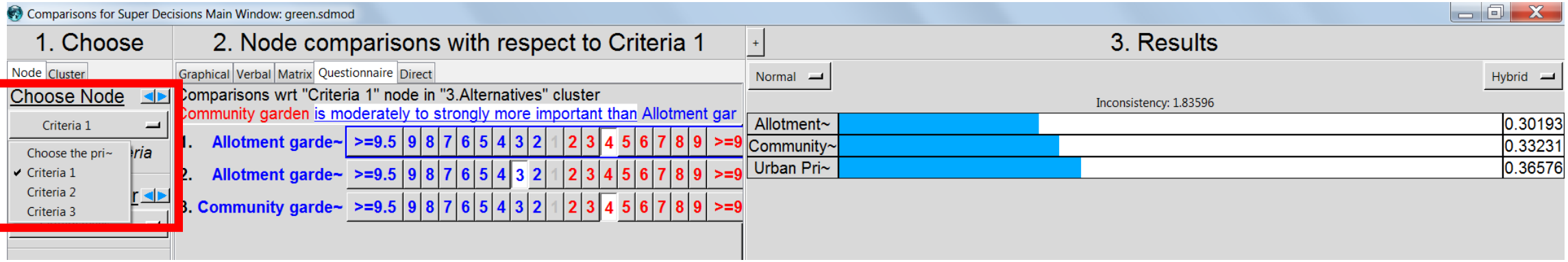
What is the most relevant criteria to have accurate answer for research question



Comparision of criteria

- 1. Compare the alternative considering each criteria (Assess/Compare/Pairwise comparision). Change from the left side of the screen with criteria that you want to compare.

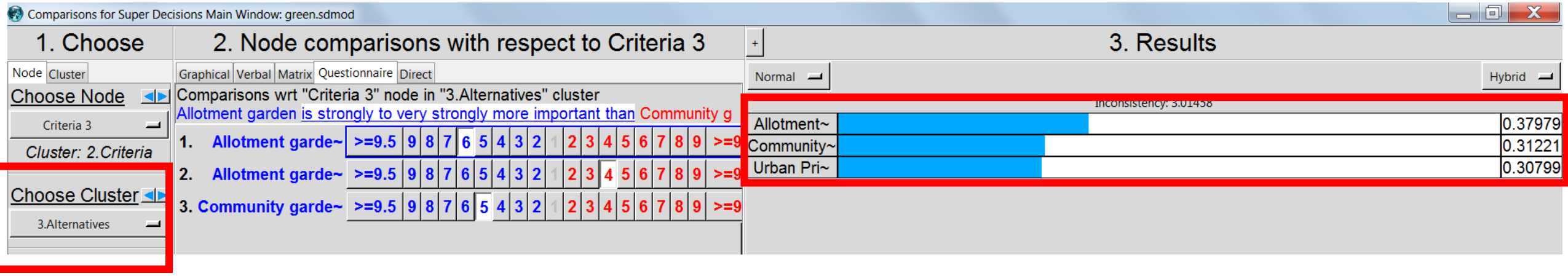
Considering criteria n, what is the best alternative?



Hierarchy of alternatives

- 1. Find the hierarchy of alternative (Assess/Compare/Pairwise comparision). Choose 3. Alternative from the left side of the screen.

Considering criteria n, what is the best alternative?



Relevant SURE activities

- **September 5, 2019 - Workshop - The challenging urban nature and nature'S role in URban challEnges** to be held in Bucharest. **Save the date! (https://ccmesi.ro/?page_id=1216)**
- Join us on www.society-urban-ecology.org

September 5, 2019 - Workshop - The challenging urban nature and nature'S role in URban challEnges to be held in Bucharest. **Save the date!**

www.society-urban-ecology.org/

https://ccmesi.ro/

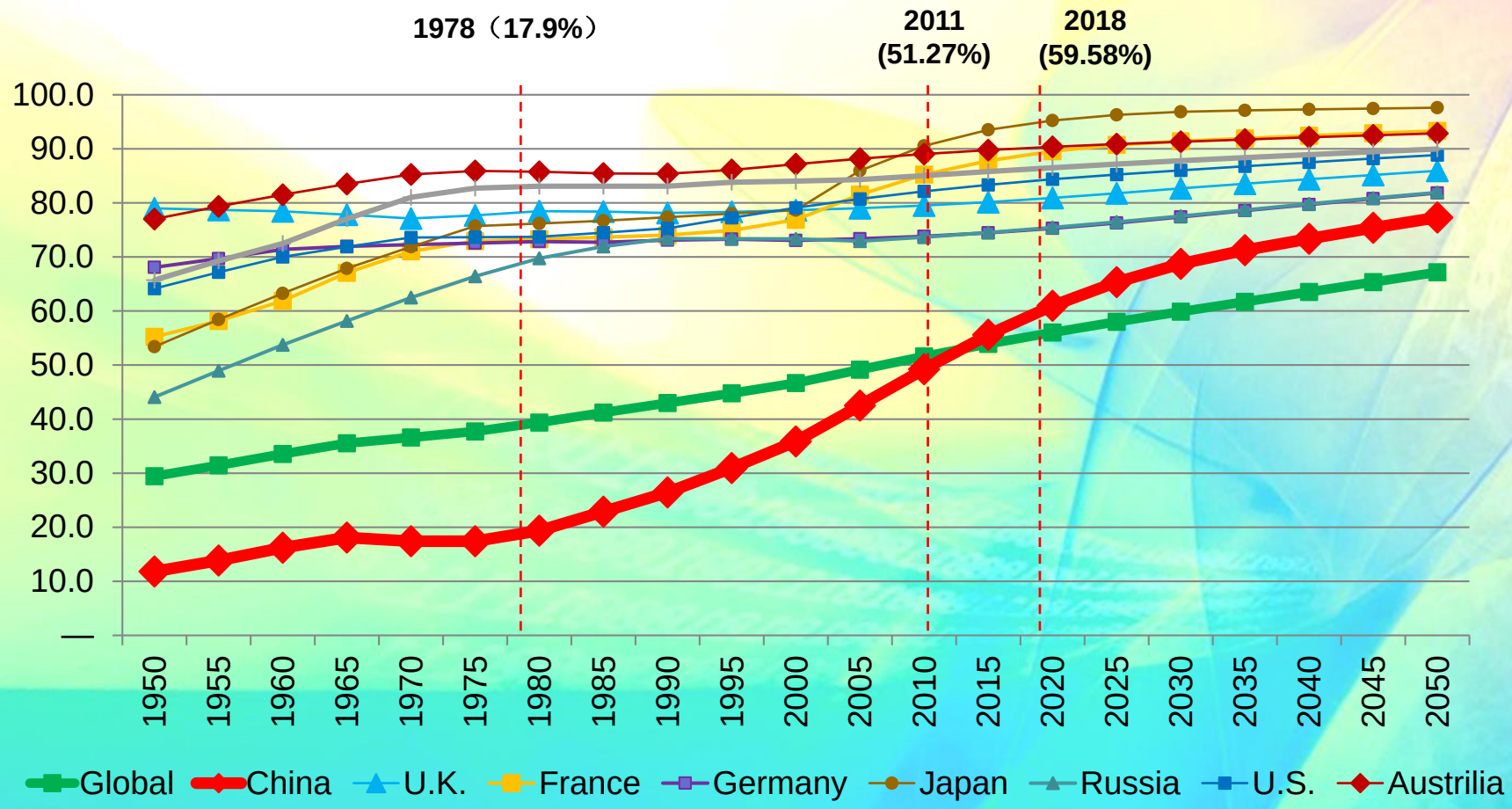
Thank you for your attention!

Planning for Eco-City Development in China

GAN Jing
Associate Professor,Department of Urban Planning,
Tongji University, Shanghai, China

2019.07.09

Rapid Urbanization in China



Source：United Nations, Department of Economic and Social Affairs, Population Division (2012). World

Sustainability Challenges of China in the context of rapid urbanization

climate-related hazards

air pollution

resource depletion

food insecurity

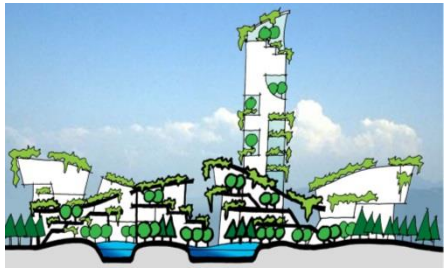
public health impact

biodiversity loss

Urban Development Transition :

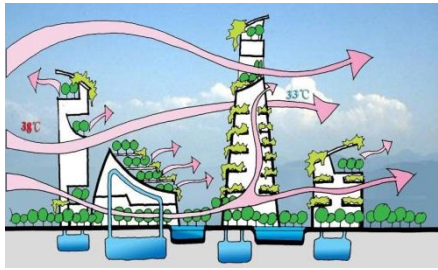
Consumers of ecosystem ⟶ Balancing human with nature

Deforestation
毁绿- 城市开发侵占和损毁绿地



Afforestation
增绿- 将地面留给自然，
结合立体绿化，大大增加绿量

Heat Island Effect
热岛- 城市热岛效应



Cooling Island Effect
凉岛- 运用水、绿、风等综合手段，降低气温

Water Pollution
污水- 城市排放物污染水体

Water Purification
净水- 合理利用并净化水体

Energy Consumption
耗能- 城市开发伴随高能耗

Energy Saving & Collection
节能采能- 大规模实现降耗节能，实验采集城市能源

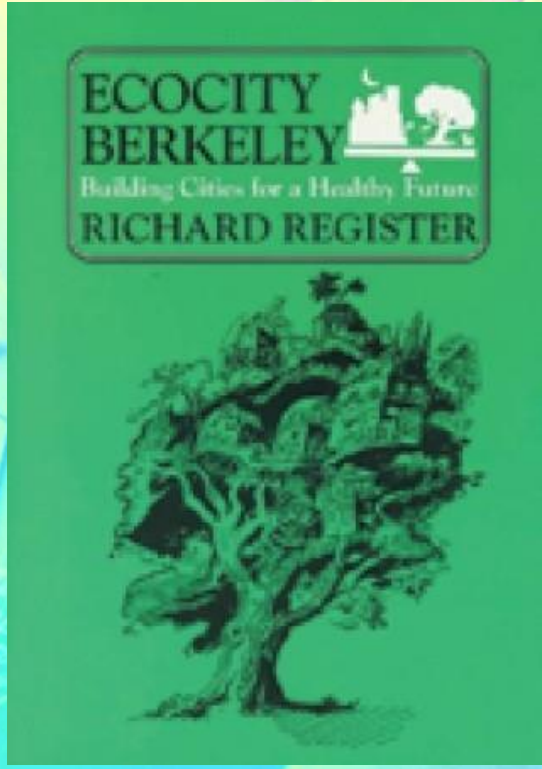
Resource: WU Zhiqiang (ed.). Sustainable Planning and Design for the World Expo 2010 Shanghai China[M]. China Architecture & Building Press 2009.

Concept of Eco-city

Richard Register(1987):

a city where human beings live in harmony with nature and therefore greatly reducing their ecological footprint

——***Ecocity Berkeley: building cities for a healthy future； rebuild cities in balance with nature***



Ecocity Builders and the International Ecocity Framework & Standards (IEFS) advisory team(2010):

An Ecocity is a human settlement modeled on the self sustaining resilient structure and function of natural ecosystems

Characteristics of Eco-City

1.Ecologically healthy

2.Urban growth with limitations

3.Continuous improvement

4.Sustainability

Low-carbon City vs Eco-City

Low-Carbon City

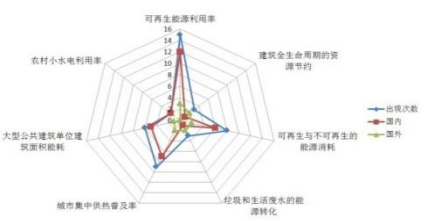
cities that decouple economic growth from the use of fossil fuel based resources by shifting society and economy towards consumption based on renewable energy, energy efficiency and green transportation with lower carbon emission.

Low-Carbon Eco-city (in Chinese context)

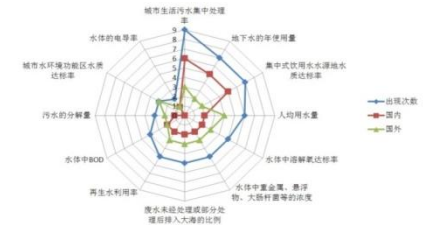
Complex human environment system with harmony among “Human-City-Natural Environment”, combined with low-carbon and ecological concepts, emphasizing on low energy consumption, sustainable economy model and environmental improvements.(Chinese Society of Urban Studies)

Eco-City Research and Practice in China

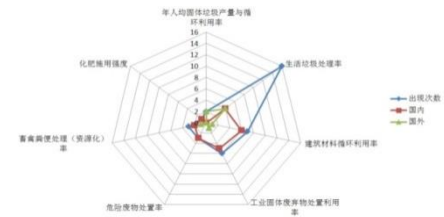
Over 97% Chinese prefecture-level cities expressing an interest in adopting an eco-city and low carbon, or low carbon eco-city development strategy (CSUS,2012)



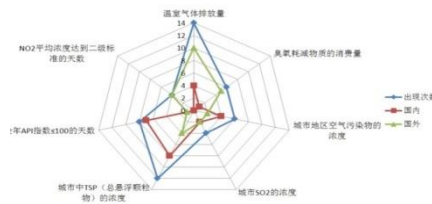
Energy



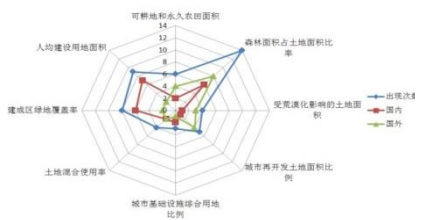
Water



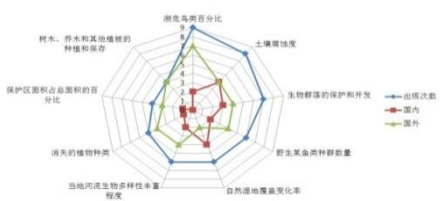
Solid Waste



Air quality & Micro-climate



Land Use



Biodiversity

Eco-city Evaluation Indexes

Pilot projects of Low carbon & Eco-City Development(by 2014)

Ministry	Name	Number
Ministry of Environmental Protection	National eco cities(countries, districts)	94
	National Ecological civilization demonstration areas	37
	National Ecological demonstration areas	528
	National Eco industrial park	26
National Development and Reform Commission	Provincial-level Low carbon pilot projects	6
	Low carbon pilot cities	36
	National Circular economy demonstration cities(counties)	40
Ministry of Housing and Urban-Rural development	Demonstrating green eco-district	19
	Green & Low carbon pilot towns	7
National Energy Administration	New energy pilot cities	81
	New energy industrial parks	8
	APEC low carbon pilot towns	27
National Development and Reform Commission, Ministry of finance, Ministry of land resource, Ministry of water resources, Ministry of agriculture and National Forestry Bureau	National ecological civilization demonstration zone	55
National Development and Reform Commission, Ministry of industry and information	National low carbon industrial park	55
Ministry of finance, Ministry of Housing and Urban-Rural development, Ministry of water resources	Pilot sponge cities	16

Thresholds of Eco city(new-build developments) by MoHURD (2011)

1. Compact Land Use Model
2. Renewable Energy >=20%
3. Green Building >=80%
4. Biodiversity
5. Green Transportation: walking, cycling, public transportation>=65%
6. Refuse industrial projects with high energy consumption and high emission

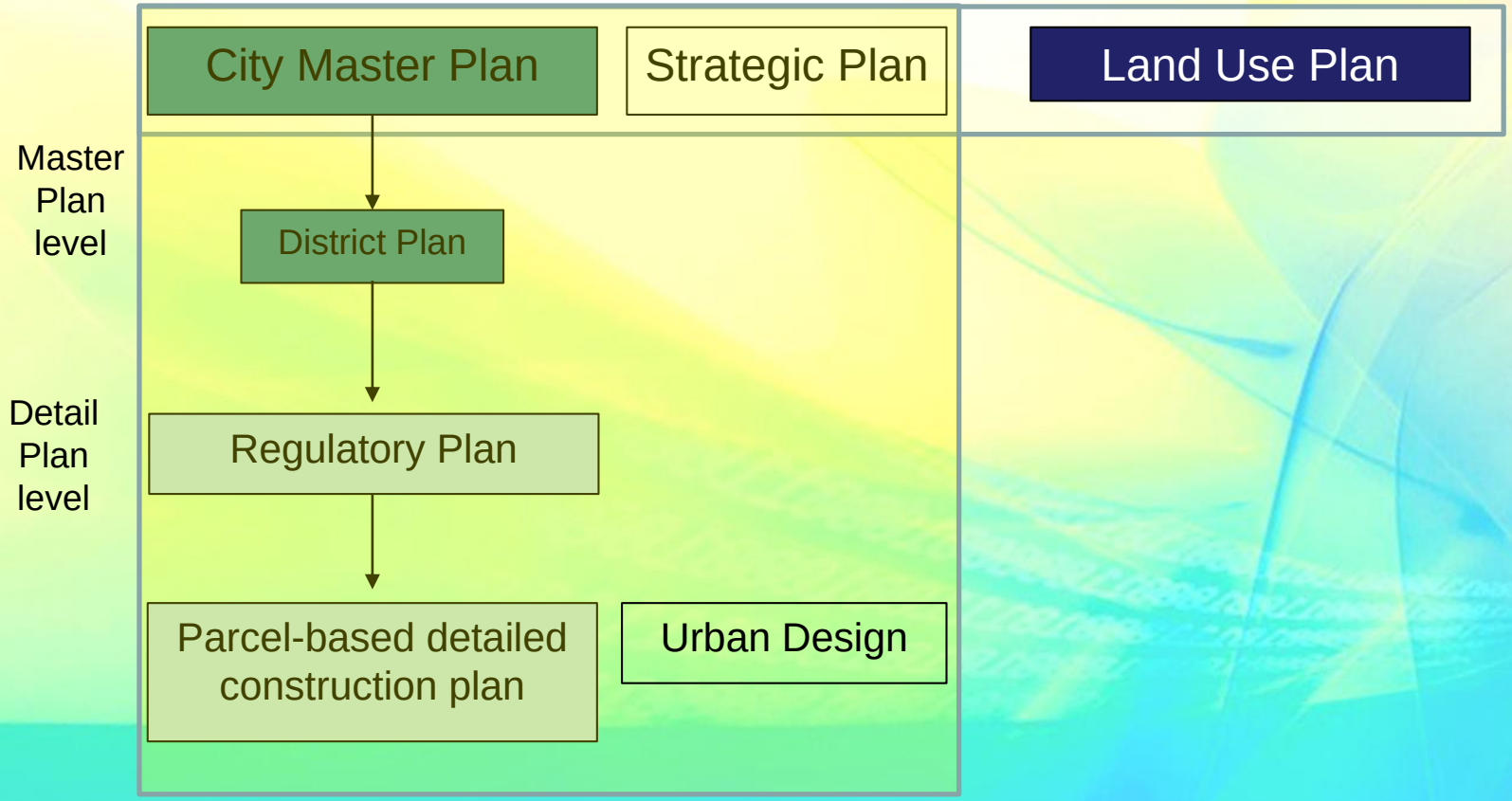
Demonstrating Green Eco Districts

Green eco-district

Assessment standard for green eco-district(GB51255-2017)

1. Land Utilization
2. Ecological Environment
3. Green Building
4. Resource and Carbon Emission
5. Green Transportation
6. Informatization Management
7. Industry and Economy
8. Humanity
9. Technical Innovation

Urban Planning System in China(before May 2019)

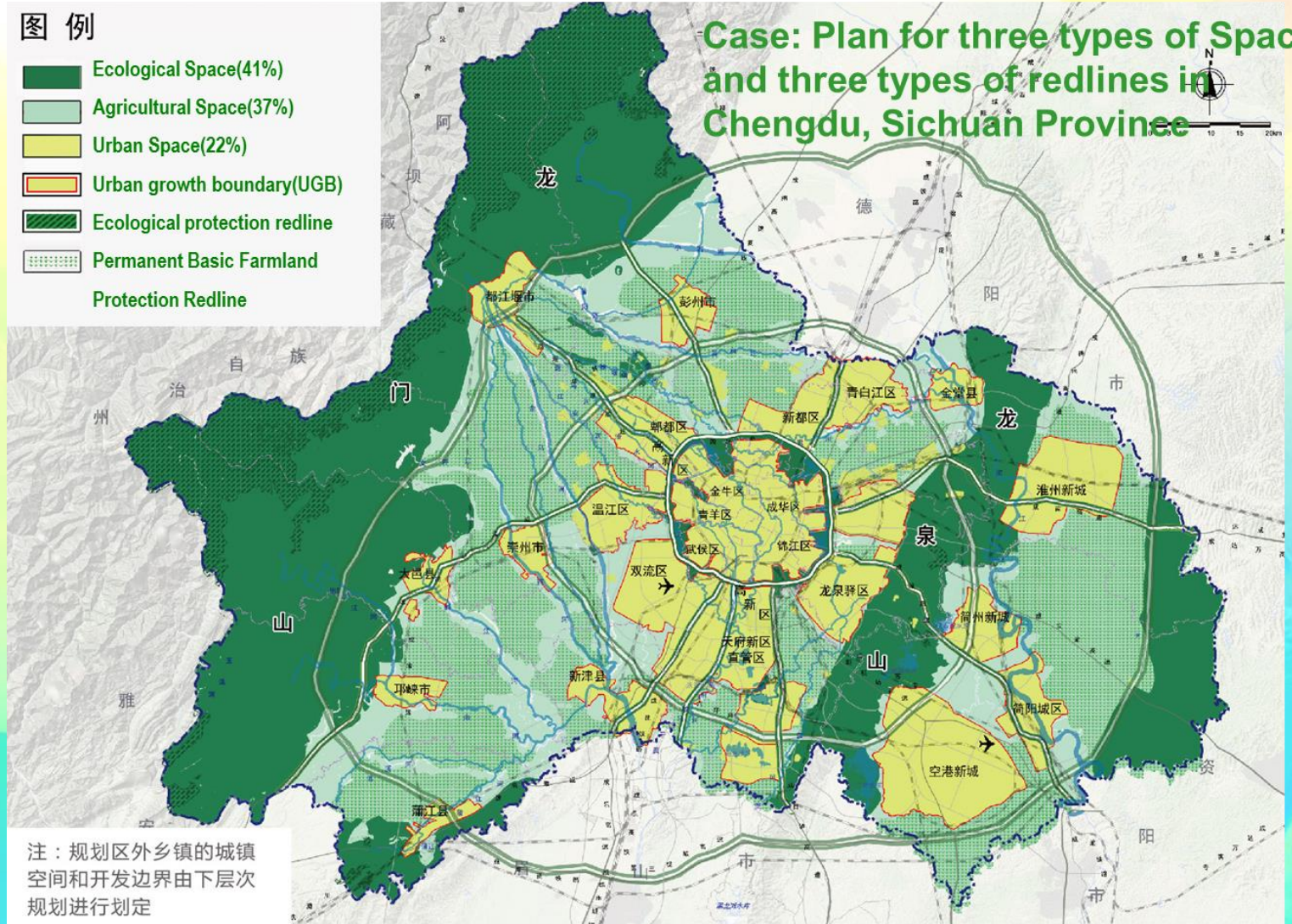


Planning strategies for Eco-city

Macro Scale(Master Plan level)

1. Carrying capacity and Land use: Determination of ecological control redlines and designation of ecological spaces
2. Structure: Urban Green-blue network and infrastructure
3. Development Rights Control(balance between protection and development): Designation of Key ecological zones with development restrictions
4. Green services for all: Urban public green spaces with suitable service radius
5. Sustainable design for grey infrastructure(transportation, water and energy supply, drainage system, solid waste…..)
6. Control Indicators

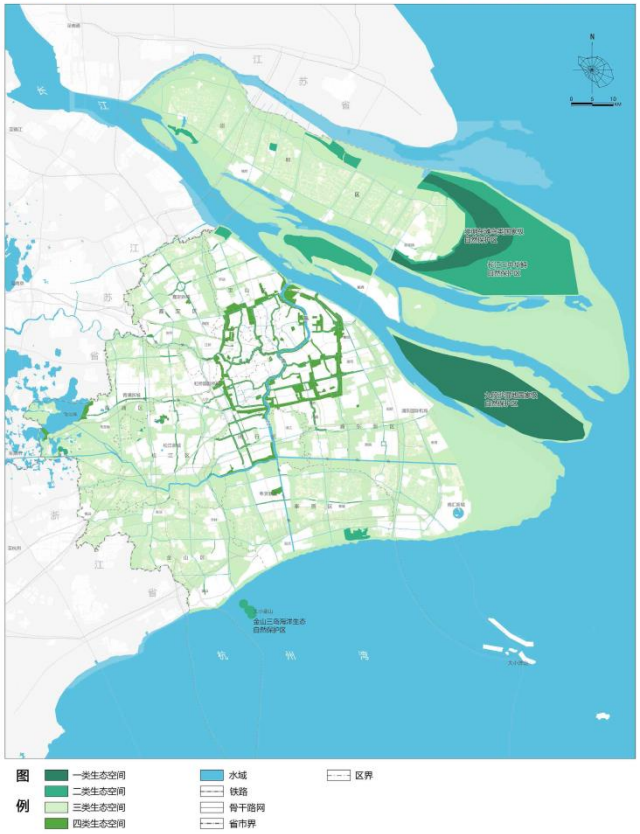
Ecological control redlines and designation of ecological spaces



2035 SHANGHAI

上海市城市总体规划(2017-2035年)

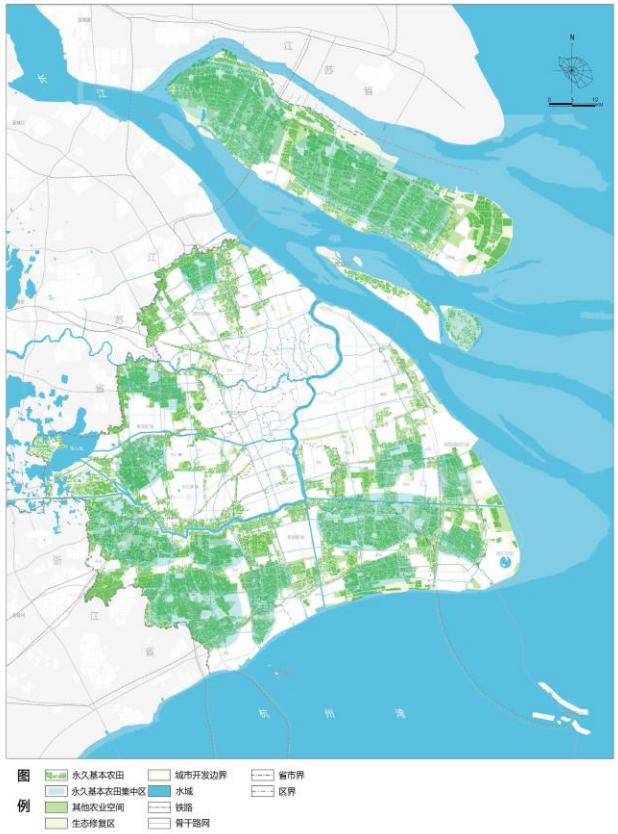
上海市域生态空间规划图



2035 SHANGHAI

上海市城市总体规划(2017-2035年)

上海市域农业空间规划图



2035 SHANGHAI

上海市城市总体规划(2017-2035年)

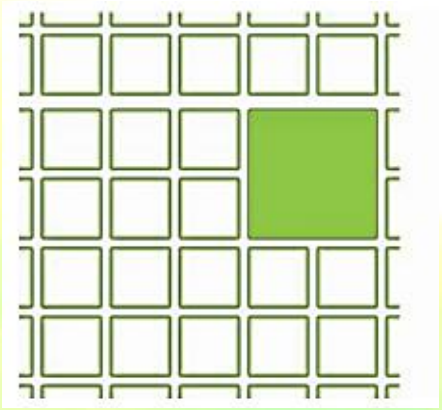
上海市域城镇空间（城市开发边界）规划图

Ecological Space

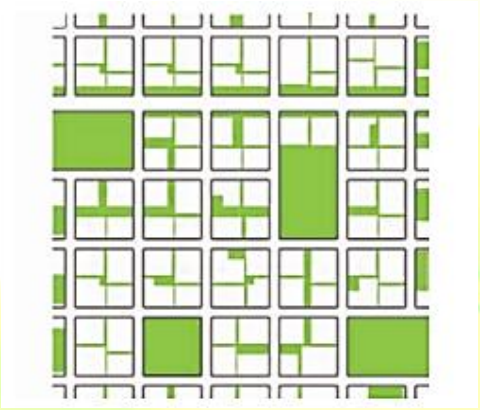
Agricultural Space

Urban Space and UGB

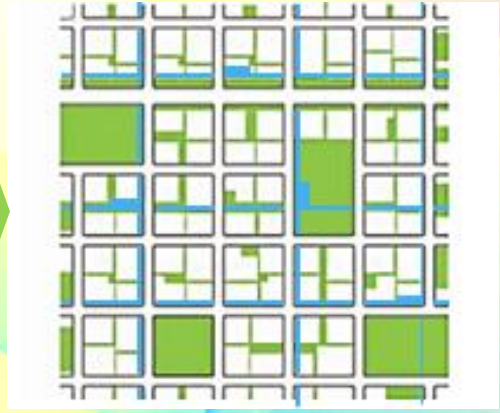
Urban Green-blue network and infrastructure



Single Green Space
单一绿地

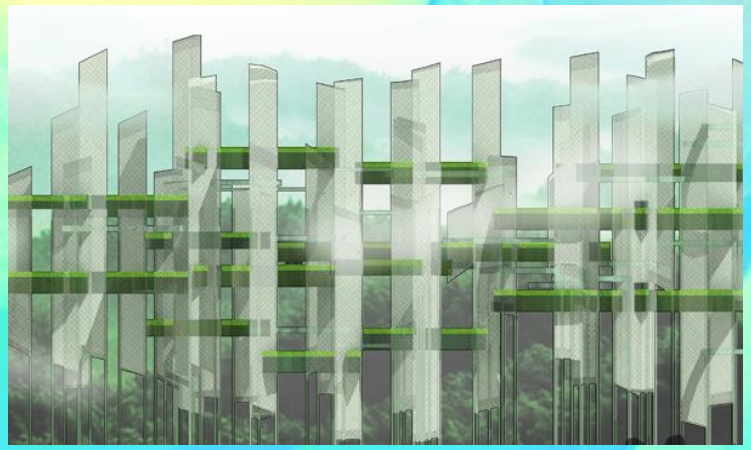


Connected Grid
联通网络



Water-Green Integration
水绿交融

2-dimensional Green Space
二维绿地

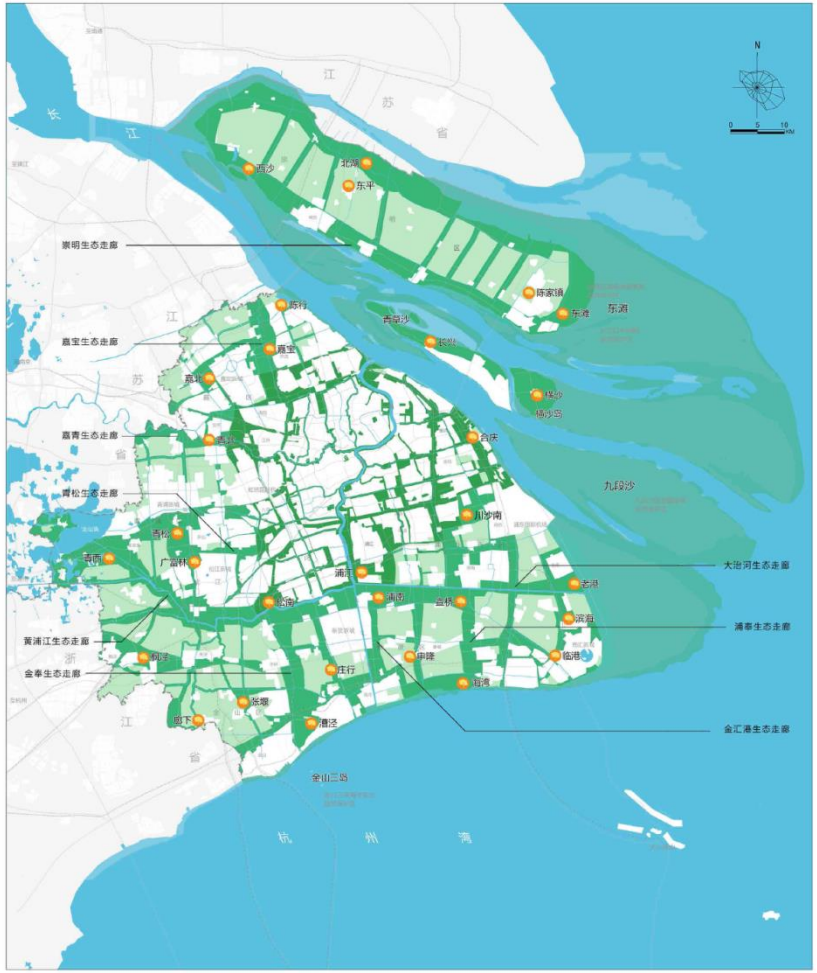


3-dimensional Green network
三维绿网

2035 SHANGHAI

上海市城市总体规划(2017-2035年)

上海市域生态网络规划图

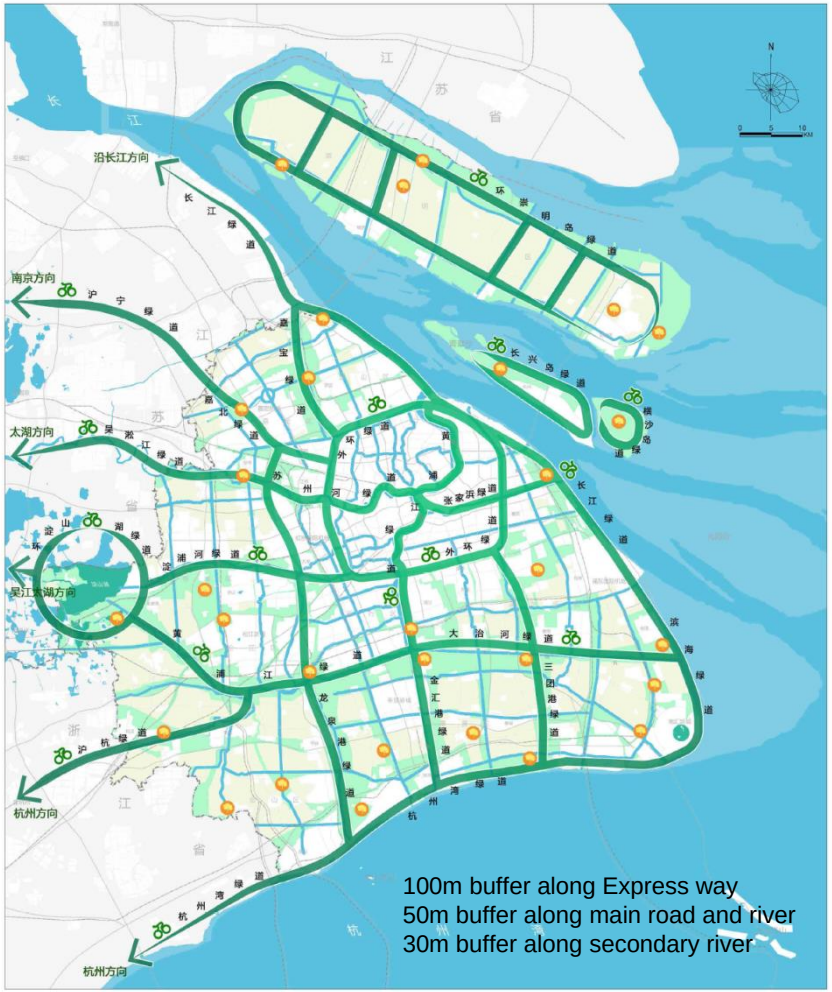


Ecological Network

2035 SHANGHAI

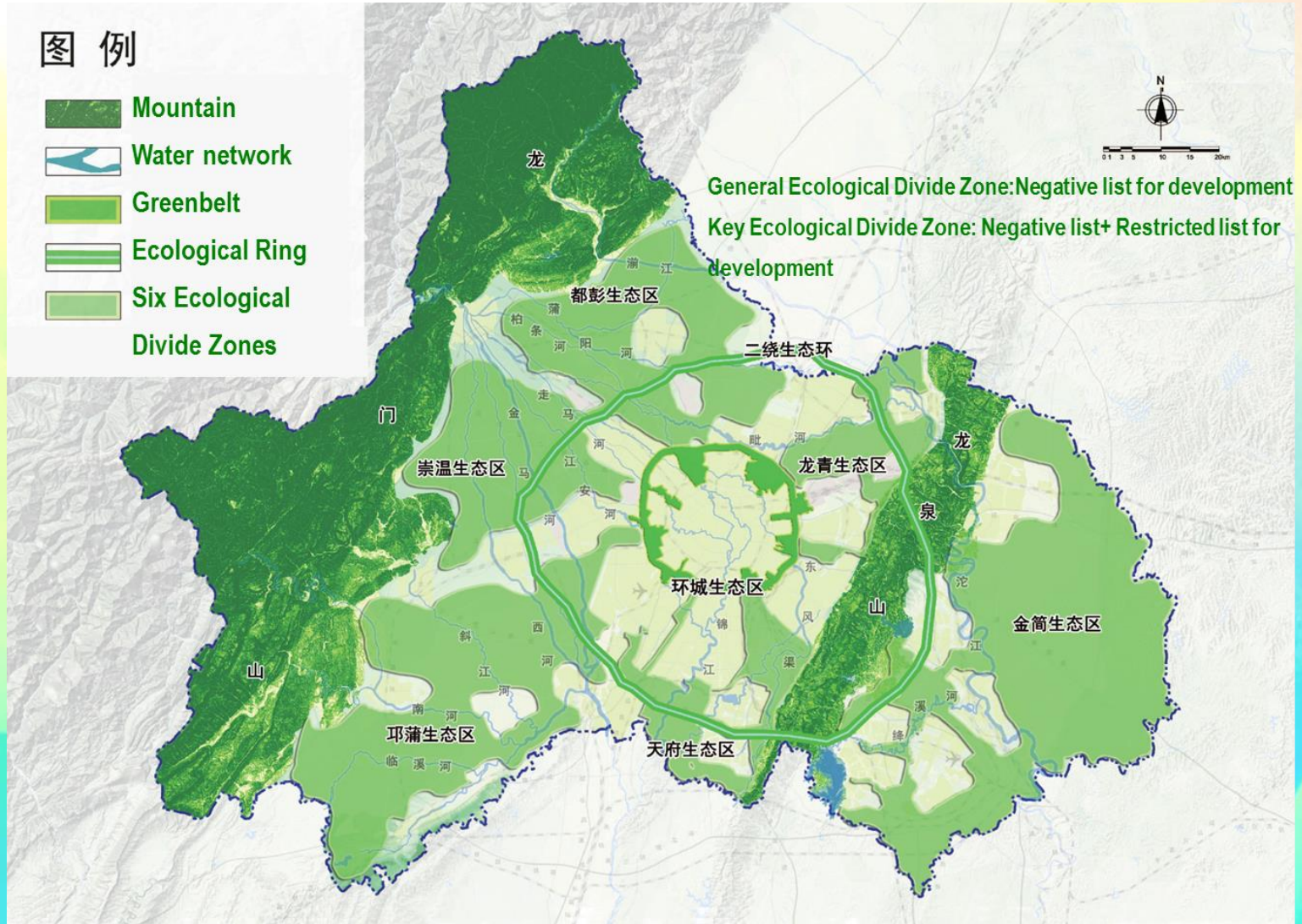
上海市城市总体规划(2017-2035年)

上海市域蓝网绿道建设规划图



Green-Blue Corridor

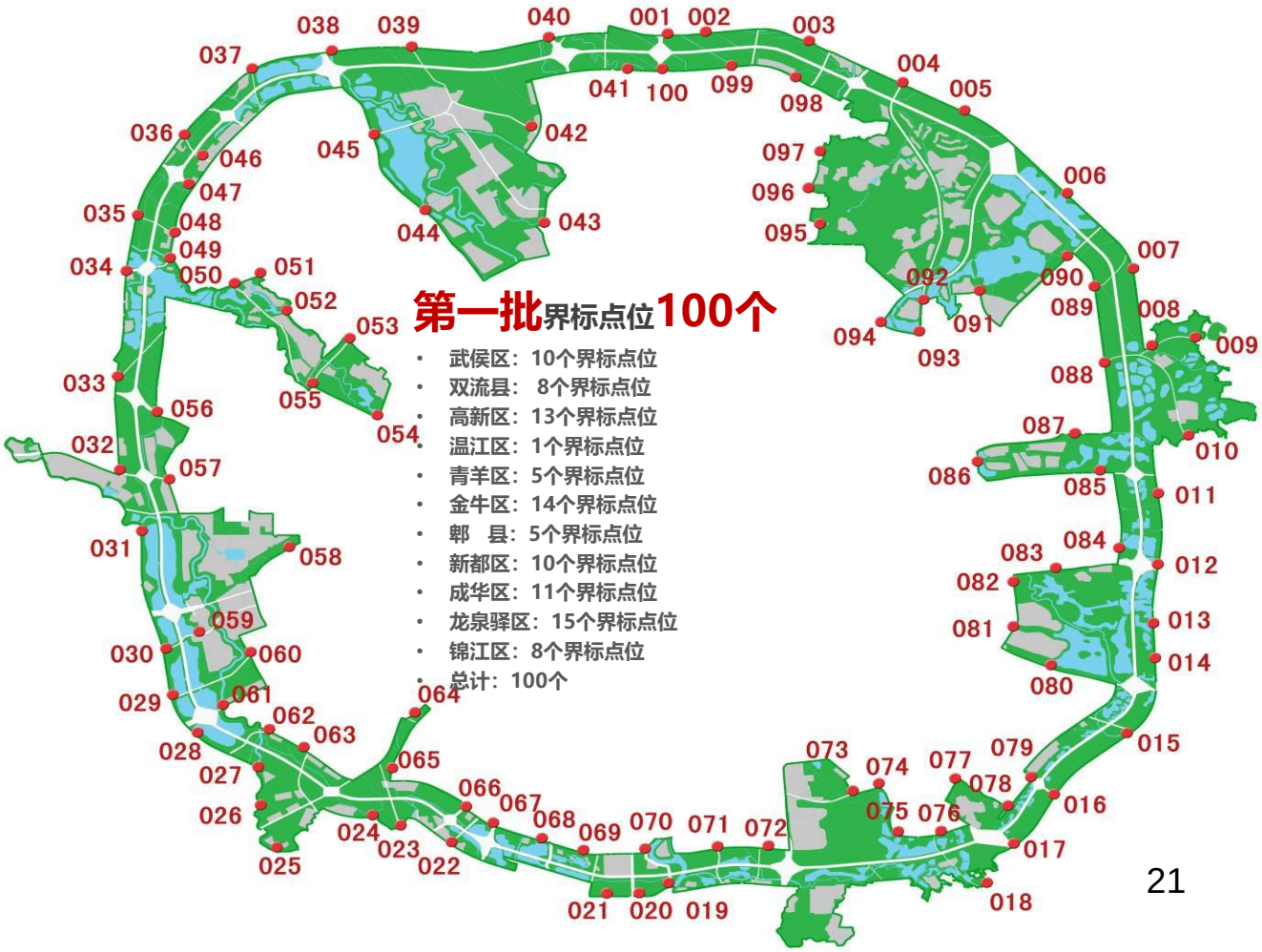
Designation of key ecological zones with development restrictions



Green Belt

首批百个界标上岗
捍卫成都“绿肺”

设置界标，接受公众监督



第一批界标点位100个

- 武侯区：10个界标点位
- 双流县： 8个界标点位
- 高新区：13个界标点位
- 温江区：1个界标点位
- 青羊区：5个界标点位
- 金牛区：14个界标点位
- 郫　县：5个界标点位
- 新都区：10个界标点位
- 成华区：11个界标点位
- 龙泉驿区：15个界标点位
- 锦江区：8个界标点位
- 总计：100个

2035 SHANGHAI

上海市城市总体规划(2017-2035年)

上海主城区绿地网络规划图

图例
- 生态走廊与生态间隔带
- 大型公园绿地
- 滨水廊道
- 外环绿带
- 楔形绿地
- 水域
- 铁路
- 骨干路网
- 省市界
- 主城区边界

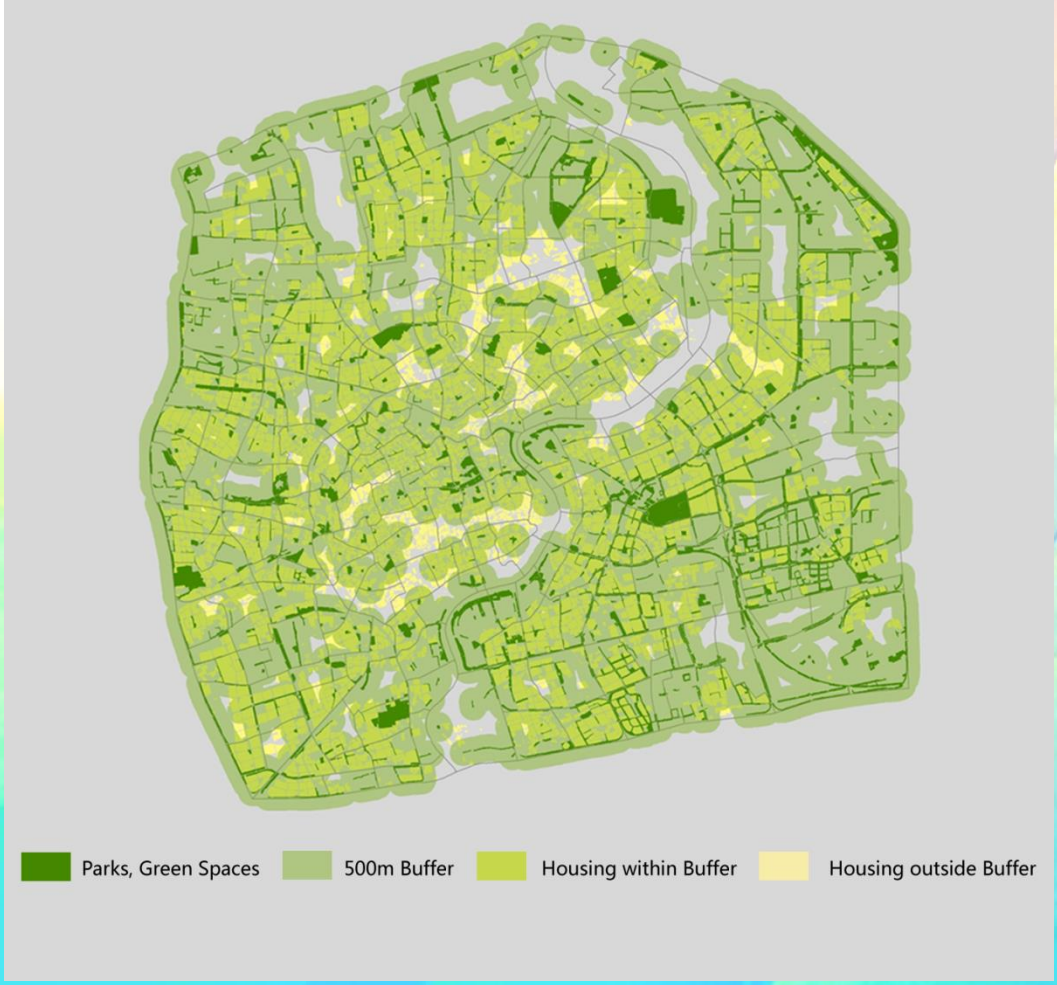
Green Belt and Wedged green space

Urban public green spaces with suitable service radius(integrate into life circle planning)

In the central city, there were still housing outside the service radius of green space (the light yellow part) in current status.

	Service radius	area
District Parks	2km	≥4hm^2
Community Parks	500m	≥0.5hm^2

Up to 90% accessibility to open public space (park and squares over 400 square meters) within 5 minutes' walking distance



Planning Control indicators for urban ecological development

Proactively respond to climate change

- Increase ratio of renewable energy sources in primary energy sources
- Reduce total carbon emission by about 5% compared to the peak in 2025

Create a green and open eco-network

- Ecological land will account for at least 60% of the total land area
- Forest coverage will be 23%
- Park green space will be up to 13 square meters per capita through efforts

Establish a sound and comprehensive environmental regulation system

- Annual mean concentration of $PM_{2.5}$ will be controlled at around 25mcg/m³.
- Compliance rate of water (environmental) function zone will be up to 100%.

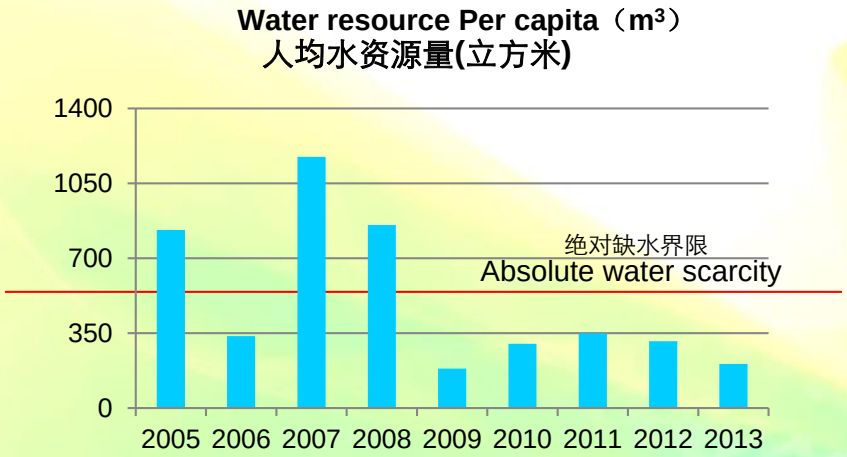
Key spatial planning strategies for Eco-city

Middle- Micro Scale(Detail Plan Level: Regulatory Plan and Urban design)

1. Land use: Layout of green-blue infrastructure with certain ecosystems
2. Form: connected green space system
3. Function: facilities and activities
4. Indicators:Zoning indicators and design guidelines
5. Design: Site and building design integrated with green technologies

Case Study: blue-green infrastructure planning for Qingdao Central Activity Zone

Water Shortage/flooding



Data of the heaviest rains in Qingdao from 7 hydrological stations
青岛地区7个站点多年一遇暴雨极值

Station 站名	Heaviest rain in 50 years 50年一遇 日雨量/mm	Heaviest rain in 100 years 100年一遇 日雨量/mm	Heaviest rain in 200 years 200年一遇 日雨量/mm
青岛qingdao	245	289	335
崂山laosshan	240	276	313
西海岸 West Coast	**259**	**308**	**358**
胶州Jiaozhou	210	239	268
即墨Jimo	251	297	346
平度Pingdu	186	209	232
莱西Laixi	173	191	210

Big but disconnected and inaccessible Green Space

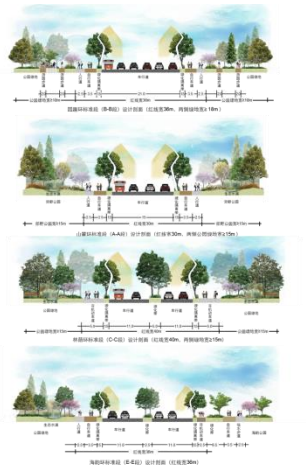
Public Plaza 政府前广场

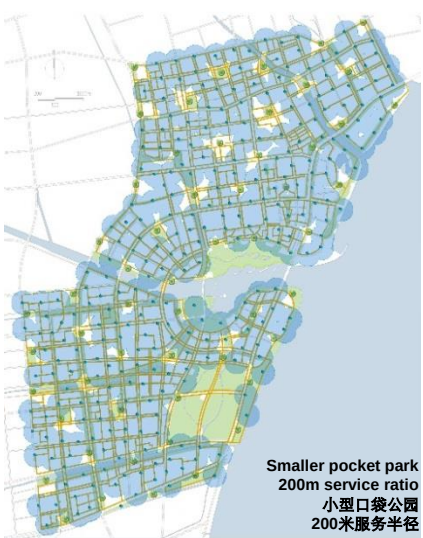
Wetland滨河湿地

Coastline Park 城市阳台

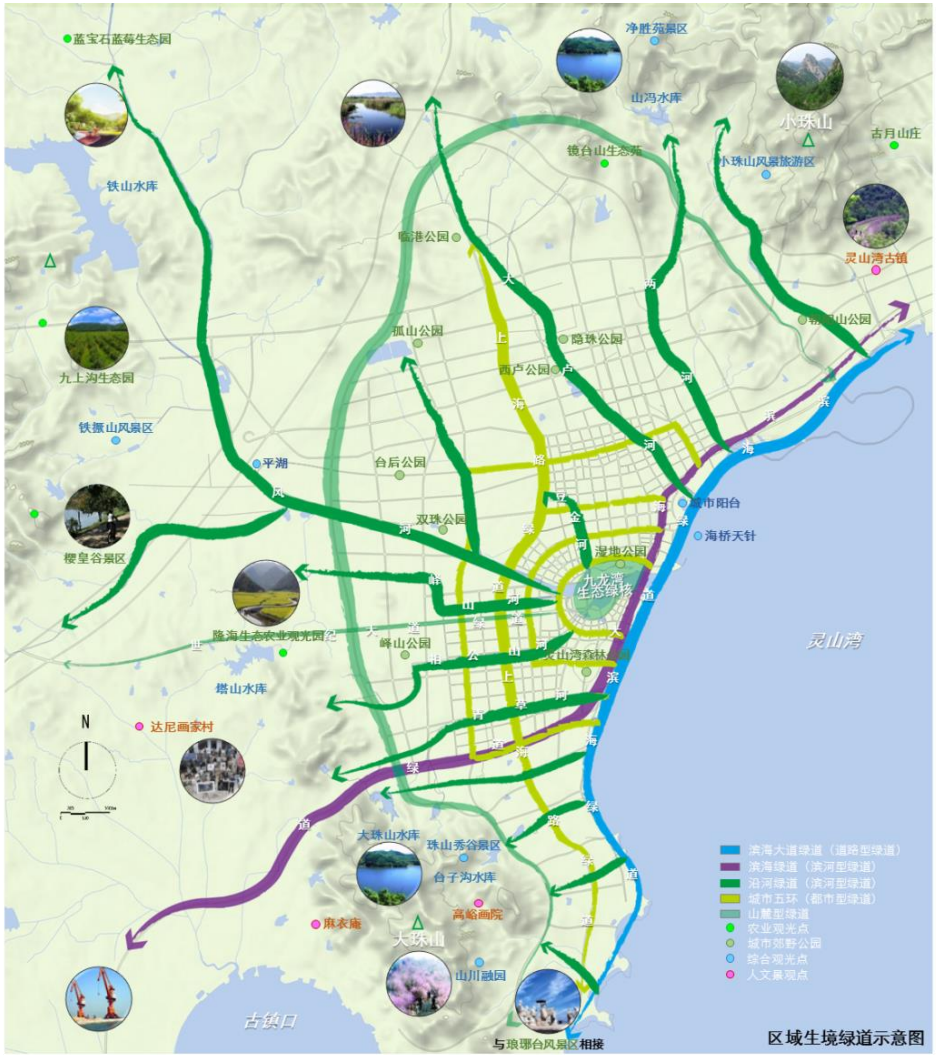
Shelter Forest 森林公园

Connected water-green space network

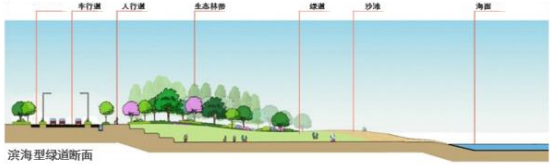




Connected water-green space network



滨海型绿道：建立区域廊道，为鸟类迁徙提供栖息处。

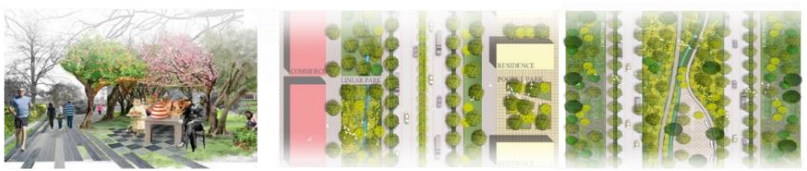


滨河型绿道：以九龙湾为核心，建立滨河廊道，沿风河等河岸形成有一定规模且郁闭度较高的生境斑块，为物种栖息和繁殖提供栖息地。

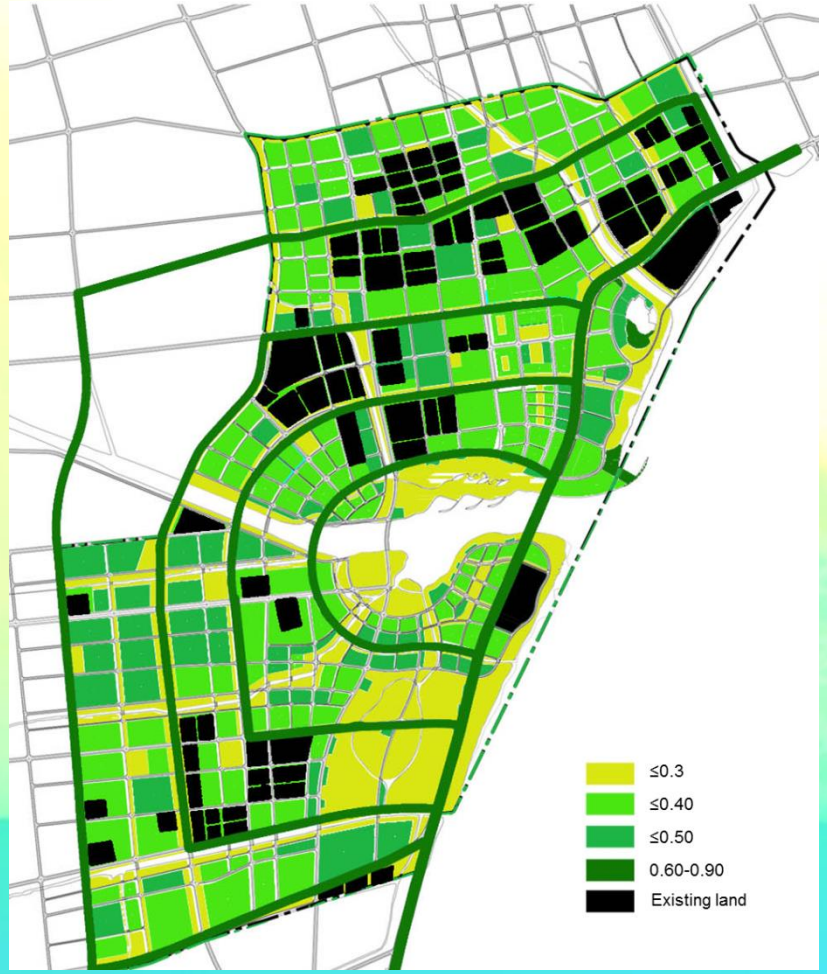
山林型绿道：在城区外围打造向周边山林延续的近自然绿道，联通郊野公园，引入慢行系统，增加人与自然的亲和界面。

道路型绿道：即滨海大道。减小断面尺寸增加步行道宽度，减慢进入该地段的车速，提高人在此的舒适性。

都市型绿道：通过线性公园、口袋花园等串联不同功能建筑，不同功能街区，不同城市区域以及不同人群的活动。



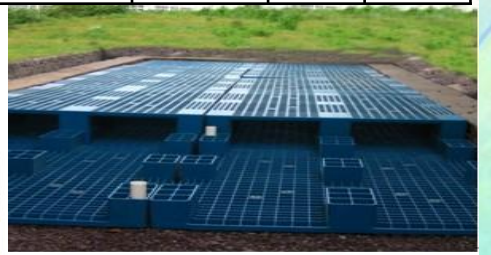
Water-sensitive Design



Zoning Plan for runoff coefficient
城市雨水径流系数控制规划

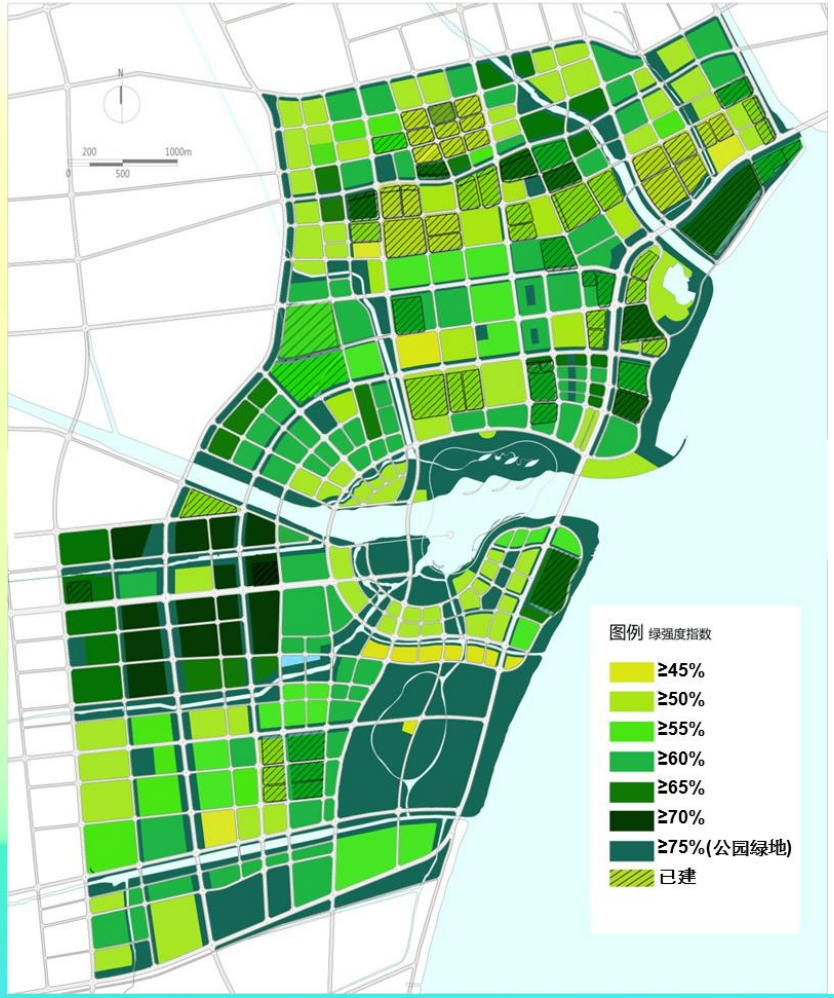
Rain and waste water flows direction雨污水处理后流向

Water resource 水来源		Water flows direction水流向			
		Self use(irrigation, washing)自用（灌溉、冲洗）	Wetland 湿地系统	River 河流	Ocean 海洋
Rain 雨水	Green space 绿地蓄水	√			
	Residential area 居住区雨水	√			
	Commercial area 商业区雨水	√			
	Public road and plaza 公共道路、广场		√	√	
Grey Water 灰水	Residential area 居住区灰水	√			
	Commercial area 商业办公区灰水		√	√	
Black Water黑水			√	√	√



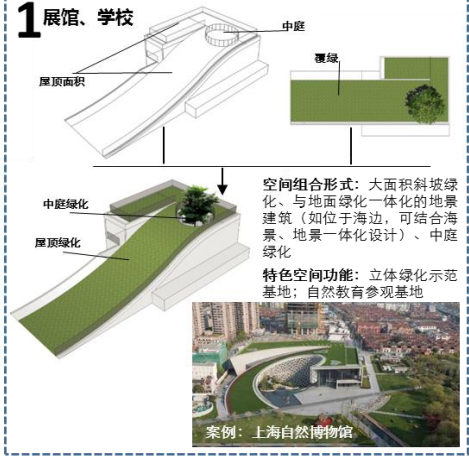
Water-sensitive Facilities
水敏性设施

Integrated green surface



Zoning Plan for Integrated green surface ratio
城市综合绿表皮控制规划

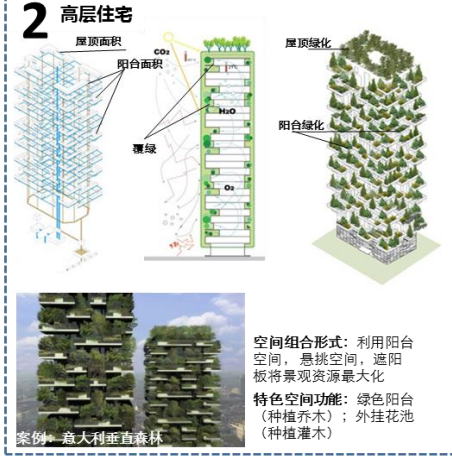
1 展馆、学校



空间组合形式：大面积斜坡绿化、与地面绿化一体化的地景建筑（如位于海边，可结合海景、地景一体化设计）、中庭绿化

特色空间功能：立体绿化示范基地；自然教育参观基地

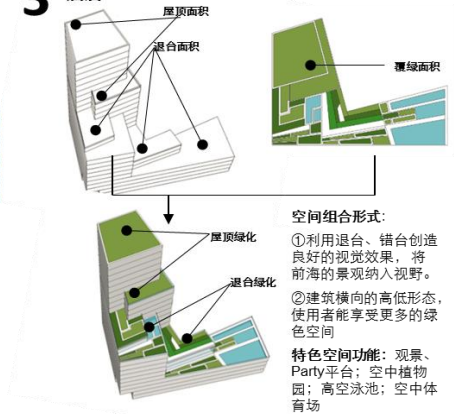
2 高层住宅



空间组合形式：利用阳台空间，悬挑空间，遮阳板将景观资源最大化

特色空间功能：绿色阳台（种植乔木）；外挂花池（种植灌木）

3 酒店



空间组合形式：

①利用退台、错台创造良好的视觉效果，将前海的景观纳入视野。

②建筑横向的高低形态，使用者能享受更多的绿色空间

特色空间功能：观景、Party平台；空中植物园；离空泳池；空中体育场

4 商住混合

空间组合形式：利用错台、退台屋顶营造半遮蔽的三明治植物墙。

特色空间功能：屋顶菜园；都市私属花园

Vertical Greening Design Guidelines
立体绿表皮设计导则

Interactive Eco Activities

Eco Activities Routes
生态活动游线

Interactive Eco Landscape Planning
活力生态景观规划

Blue-green infrastructure as human's contact to Nature
蓝绿基础设施作为人类接触自然、体验自然、与自然互动的界面

Indicators for each block of pilot area(eco zoning indicators)

（1） Energy

- Utilization ratio of solar photothermal area (%)
- Utilization ratio of Solar photovoltaic area (%)
- Availability of Geothermal/Seawater Source/Sewage Source Heat Pump
- Priority Applicability of Distributed energy grid

（2） Water

- Rainwater runoff control rate (%)
- Permeable area ratio of outdoor space(%)

（3） Solid waste

- Domestic Waste Classification Collection a Transportation Station

（4） Micro-climate

- Wind speed in pedestrian area （m/s）

（5） Green Space

- Integrated green surface ratio （%）

（6） Biodiversity

- Tree Canopy ratio（%）


Thank You!
jinggan@tongji.edu.cn

UNESCO GLOBAL GEOPARK
KULA (Turkey)

Assoc. Prof. Dr. Arife KARADAĞ
Ege University (Izmir-TURKEY)
arife.karadag@ege.edu.tr

What Is Geopark?

Geoparks are single, unified geographical areas where sites and landscapes of international geological significance are managed with a holistic concept of

protection,

education,

and

sustainable development.

Geoparks stands for:

- **Education**
- **Science**
- **Culture**
- **Communication**

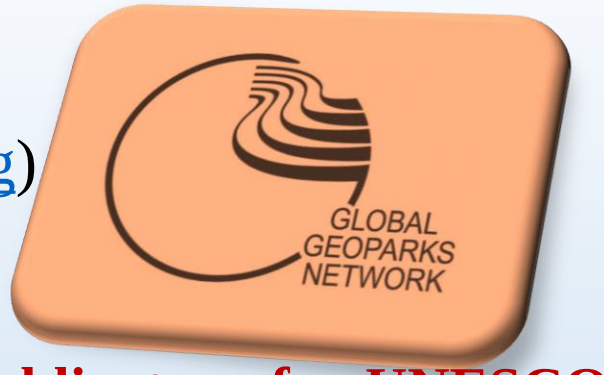
Education and popularization of science play an important part within the broad range of educational activities happening in Geoparks for all groups of populations.

Geo-Science – and research based on geological settings, with back-up from academics – come naturally in Geoparks.

Cultural aspects within a Geopark, significant for regional identity, are living tangible and intangible components, and are an integral part of a Geopark; they are closely related to the landscape people live in.

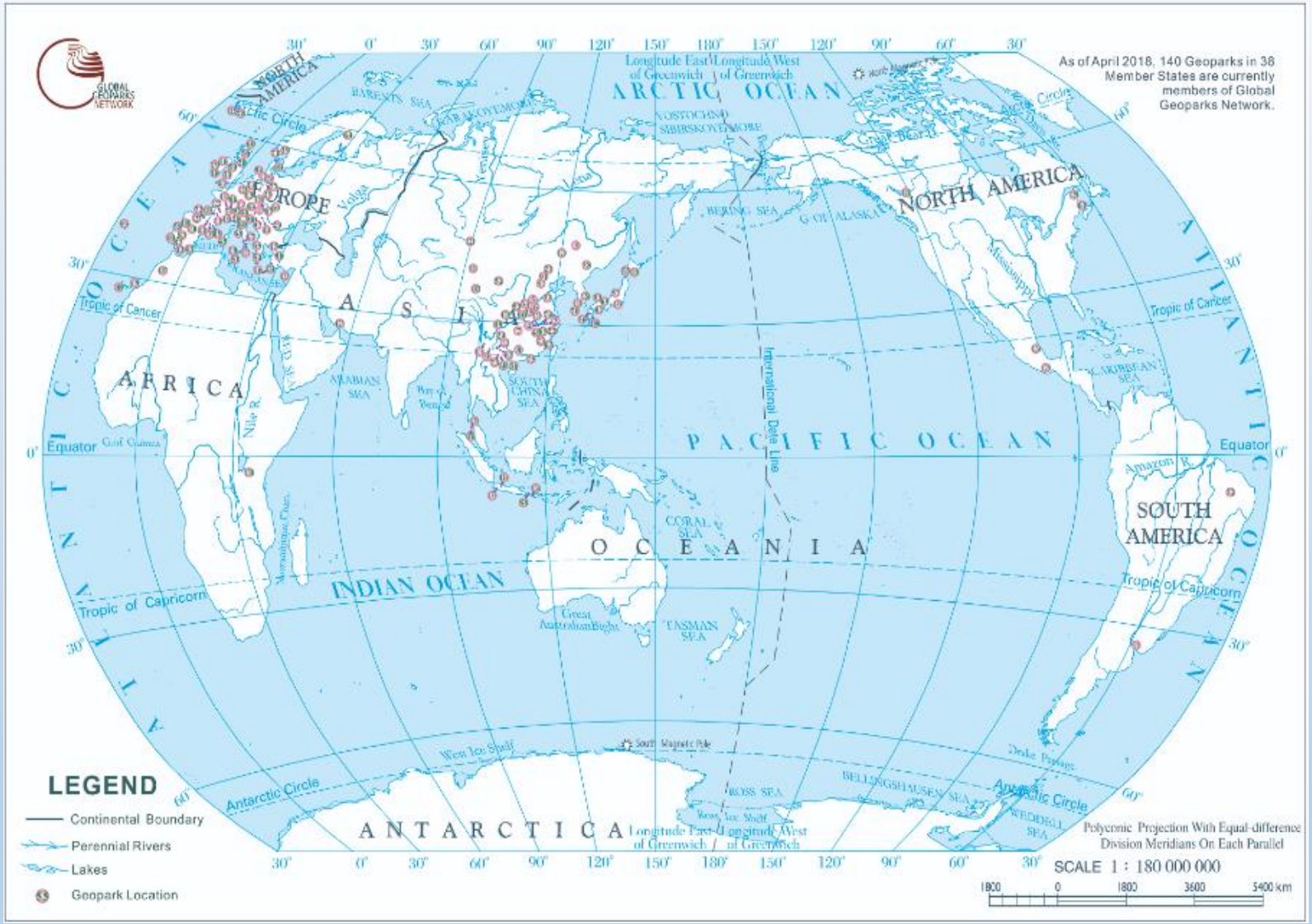
A sound Communication is an essential part of the Global Geoparks Network, and members are not just members of a list; membership means active communication between Geopoarks across physical and political boundaries, leading to cooperation projects and true exchange.

Global Network of National Geoparks (http://www.globalgeopark.org)



- **The Global Geoparks Network (GGN), of which membership is obligatory for UNESCO Global Geoparks, is a legally constituted not-for-profit organisation with an annual membership fee.**
- **The GGN founded in 2004 is a dynamic network where members are committed to work together, exchange ideas of best practise, and join in common projects to raise the quality standards of all products and practises of a UNESCO Global Geopark.**
- **Now the GGN continues to expand, drawing in new expertise and knowledge from all parts of the world and different cultures. And it's always developing models of best practice and setting high quality standards for territories that integrate the preservation of geological heritage into strategies for regional sustainable economic development.**

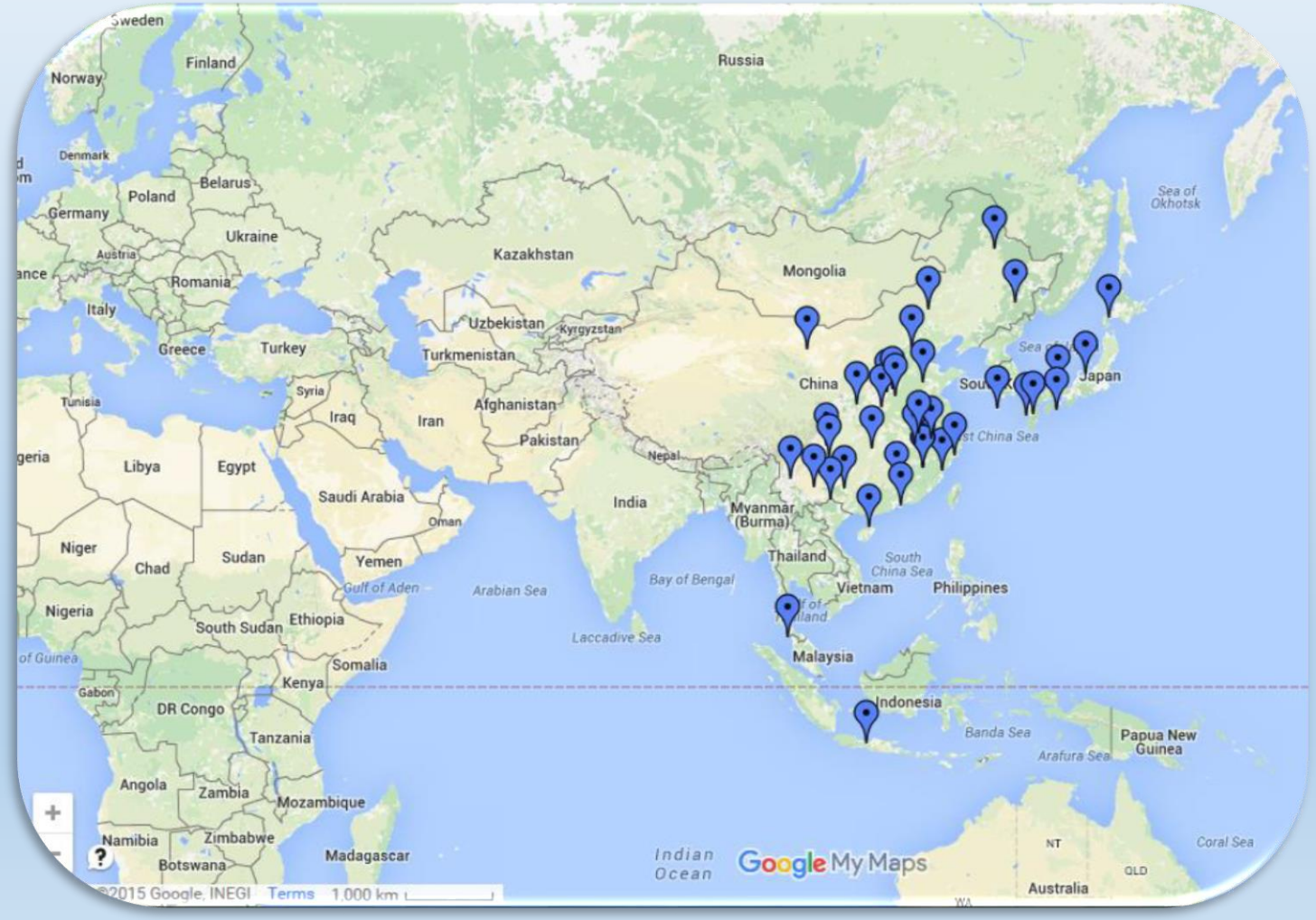
Distribution of GGN Member



As of April 2018, 140 Geoparks in 38 Member States are currently members of the Global Geoparks Network.

It is a pre-requisite that all UNESCO Global Geoparks develop and operate educational activities for all ages to spread awareness of our geological heritage and its links to other aspects of our natural, cultural and intangible heritages. UNESCO Global Geoparks offer educational programmes for schools or offer special activities for children through "Kids Clubs" or special "Fossil Fun Days". **UNESCO Global Geoparks also offer education, both formal and informal, for adults and retired people while many provide training for local people who can then, in turn, teach others.**

Asia Pacific Geoparks Network (http://asiapacificgeoparks.org/)

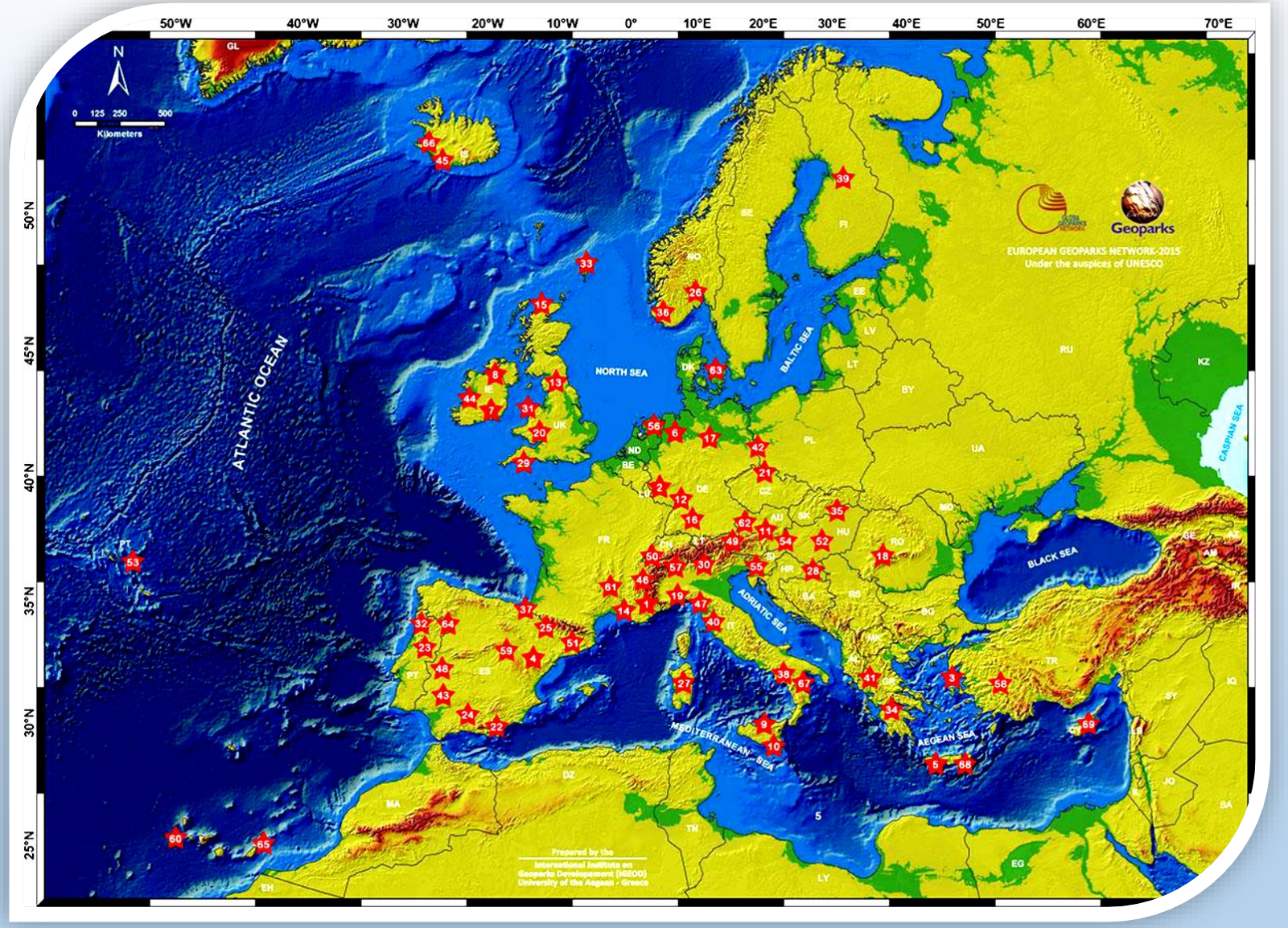


European Geoparks Network

The European Geopark Network (EGN), founded in 2000, aims

- to promote geological heritage,
- to preserve geodiversity,
- to promote sustainable economic growth of geopark and
- to support development of geological tourism.

The network, which initially consisted of 4 countries, was extended to 69 Geoparks in 23 European countries as of 2015.



http://www.europeangeoparks.org/

58th Kula Geopark

	Name	Country
1	Reserve Geologique de Haute-Provence	France
2	Vulkaneifel Geopark	Germany
3	Lesvos Geopark	Greece
4	Parque Cultural del Maestrazgo	Spain
5	Psiloritis Natural Park	Greece
6	Geo and Naturepark TERRA.vita	Germany
7	Copper Coast Geopark	Ireland
8	Marble Arch Caves Global Geopark	Ireland
9	Madonie Geopark	Italy
10	Rocca di Cerere Geopark	Italy
11	Nature Park Steirische Eisenwurzen	Austria
12	Bergstrasse-Odenwald Geopark	Germany
13	North Pennines AONB European Geopark	UK
14	Luberon, Parc Naturel Regional	France
15	North West Highlands Geopark	UK
16	Swabian Albs Geopark	Germany
17	Geopark Harz . Braunschweiger Land. Ostfalen	Germany

	Name	Country
18	Hateg Country Dinosaurs Geopark	Romania
19	Parco Del Beigua	Italy
20	Fforest Fawr Geopark	UK
21	Bohemian Paradise	Czech Republic
22	Cabo de Gata – Nijar Natural Park	Spain
23	Naturtejo Geopark	Portugal
24	Subbeticas Geopark	Spain
25	Sobrarbe Geopark	Spain
26	Gea Norvegica Geopark	Norway
27	Geological, Mining Park of Sardinia	Italy
28	Papuk Geopark	Croatia
29	English Riviera Geopark	UK
30	Parco Naturale Adamello Brenta	Italy
31	GeoMôn GeoPark	UK
32	Arouca Geopark	Portugal
33	Geopark Shetland	UK
34	Chelmos – Vouraikos Geopark	Greece

35	Novohrad – Nograd Geopark	Hungary & Slovakia
36	Magma Geopark	Norway
37	Basque Coast Geopark	Spain
38	Parco Nazionale del Cilento e Vallo di Diano	Italy
39	Rokua Geopark	Finland
40	Tuscan Mining Park	Italy
41	Vikos – Aoos Geopark	Greece
42	Muskau Arch Geopark	Germany & Poland
43	Sierra Norte de Sevilla Natural Park	Spain
44	Burren and Cliffs of Moher	UK
45	Katla Geopark	Iceland
46	Massif des Bauges Geopark	France
47	Apuan Alps	Italy
48	Villuercas-Ibores-Jara	Spain
49	Carnic Alps Geopark	Austria
50	Chablais Geopark	France
51	Central Catalunya Geopark	Spain
52	Bakony-Balaton Geopark	Hungary

53	Azores Geopark	Portugal
54	Karavanke/Karawanken	Slovenia & Austria
55	Idrija Geopark	Slovenıa
56	Hondsrug Geopark	The Netherlands
57	Sesia - Val Grande Geopark	Italy
58	***Kula Geopark***	***Turkey***
59	Molina and Alto Tajo Geopark	Spain
60	El Hierro	Spain
61	Monts d'Ardèche	France
62	Erz der Alpen	Austria
63	Odsherred	Denmark
64	Terras de Cavaleiros	Portugal
65	Lanzarote and Chinijo Islands Geopark	Spain
66	Reykjanes Global Geopark	Iceland
67	Geopark of Pollino	Italy
68	Sitia Geopark	Greece
69	Troodos Geopark	Cyprus

http://www.europeangeoparks.org/

UNESCO Global Geoparks and Their Contribution to the Sustainable Development Goals

An Example: Geoparks, Destinations for Tourism and Geotourism

- **Supporting tourism as an instrument for territorial development with strategies designed for the sustainable conservation of an area's heritage.**
- **Creating new forms of marketing linked to quality standards which meet the requirements of a global market.**
- **Encouraging the emergence of new, less developed regions as competitive tourist destinations and revitalizing existing tourism areas experiencing a slow down in growth.**
- **Establishing cooperation between regions.**
- **Raising awareness of the social impacts associated with the growth of tourism.**

GEOTOURISM

A GEOPARK stimulates *economic activity* and *sustainable development* through geotourism. By attracting increasing numbers of visitors, a GEOPARK stimulates *local socio-economic development* through the promotion of a quality label linked with the local natural heritage. It encourages the creation of local enterprises and cottage industries involved in *geotourism* and *geoproducts*.

Geotourism is a new term for a relatively old idea. Geotourism is a form of natural area tourism that specifically focuses on geology and landscape. The term geotourism refers to the *utilization of geological heritage resources for education-based tourism.* Geotourism also *focuses on cultural and historical aspects,* such as buildings constructed from local rocks and stones and various forms of mining activity.

Geopark Process and Turkey

Related Instıtutıons and Organizations

- UNESCO National Commission of Turkey
- Environment and Urban Ministry
- General Directorate of Mineral Research and Exploration
- General Directorate of National Parks
- Ministry of Forestry and Water Management
- Geological Heritage Conservation Association

Rules and Criteria for National Geoparks seeking UNESCO's assistance to join the Global Geopark Network

1 Size and Layout

A geopark is a geographical area that includes geological heritage sites where *conservation, education* and *sustainable development* are a *holistic concept*.

Geopark should take into account *not only* the geological sites of the region, *but also* all the geographical settlements of the region.

The synergy between *tangible* and *intangible heritage* (non-geological) such as geodiversity, biodiversity and culture should be emphasized as *integral parts of each geopark*. Thus, their importance regarding landscape and geology can be shown to the visitors.

Therefore, in every geopark include and emphasize sites with *ecological, archaeological, historical* and *cultural* values.

2 Management and Local Participation

The presence of impressive and international geological outcrops alone *is not enough to be a geopark*.

The establishment of an *effective management system* and *implementation program* is a prerequisite for any approved Geopark proposal.

Geological and non-geological features within a geopark area should be *accessible* and *interrelated* to visitors.

A secure protection can be ensured through the local support management structure and partnership.

The governing body or partnership *should have effective management* with infrastructure, sufficient qualified personnel and sustainable financial support.

3 Economic Development

One of the main strategic objectives of a geopark is *to promote economic activities within the framework of sustainable development.*

A geopark seeking UNESCO assistance should provide services to promote *culturally* and *environmentally sustainable* socio-economic development.

This has a direct impact on the improvement of *rural* and *urban environment* and *human living conditions.*

4 Education

A geopark organize and provide support to the public with tools and activities to *describe earth information, environmental and cultural concepts.*

It also encourages *scientific research,* collaboration with universities, scientists and local people in a wide range of disciplines.

5 Protection

Responsible authorities are required to ensure the legal protection of the geopark in accordance with local customs and legal obligations.

This is the government of the country in which the geopark is located, which determines the level of protection of geological formation.

6 Global Network

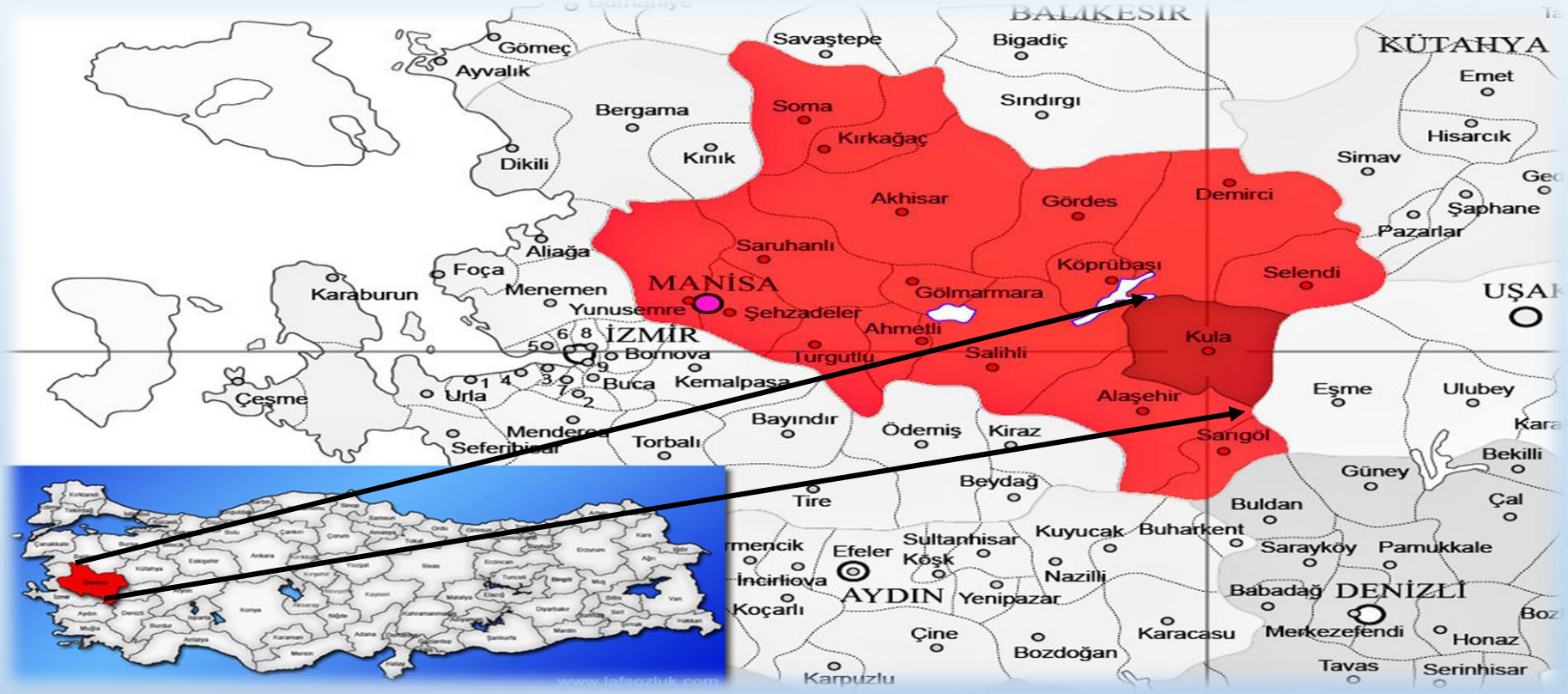
GGN provides a platform for *exchange and collaboration between practitioners and experts* on geological heritage issues.

Under the umbrella of UNESCO and in cooperation with global network partners, important local and national geological sites are recognized worldwide and benefit through *exchange of knowledge and expertise, experience and staff among other geoparks.*

This international partnership, created by UNESCO, offers *the advantages of being a member of the worldwide network* compared to a local isolated initiative.

This network enables any geopark participant to *benefit from the knowledge and experience of other members of the network.*

Turkey's Fırst and Only Registered Geopark: Kula (Katakekaumene)



Kula Volcanic UNESCO Global Geopark is situated in the Aegean Region of Turkey, at Western Anatolia within Manisa Province. The area starts from 200 m in Salihli Town and rises up to 600 m. mean elevation in Kula Town.

Kula is *the youngest volcanic region* in Turkey. The Quaternary volcanism in the area formed in three eruptive phases (1.1 million years to 300.000 and 15.000 years ago).

The outstanding volcanic structures of the UNESCO Global Geopark area are well known since antique times where the great ancient *Greek Geographer Strabo* (63 BC-24 AD) in his majestic book *"Geographica" named Kula as "Katakekaumene"* (fire-born) because of the coal-black lava.

Kula Volcanic UNESCO Global Geopark *has a complex geology* due to the active tectonic regime in the Aegean extensional province, which is one of the most seismically active and rapidly deforming regions in the world dominated by converging plates, subduction collision related geodynamic process.

Kula Volcanic UNESCO Global Geopark rests on the metamorphic basement of the Menderes massif and the ophiolitic mélange units of the Izmir-Ankara Zone, a remnant of the Tethyan Ocean. It represents 200 million years of Earth history from Palaeozoic metamophics to Holocene volcanism.

The Process of Kula Becoming a Geopark

Kula has a 10-year history of being declared a Geopark.

In 2007-2008, the process of becoming a geopark was started with a project received within the framework of EU grant programs.

In 2011, a project unit was established to obtain an international geopark quality certificate, and in November 2012, the first official application was made to the Global Geopark Network.

Kula was an official candidate for Turkey's first Global Geopark in March 2013

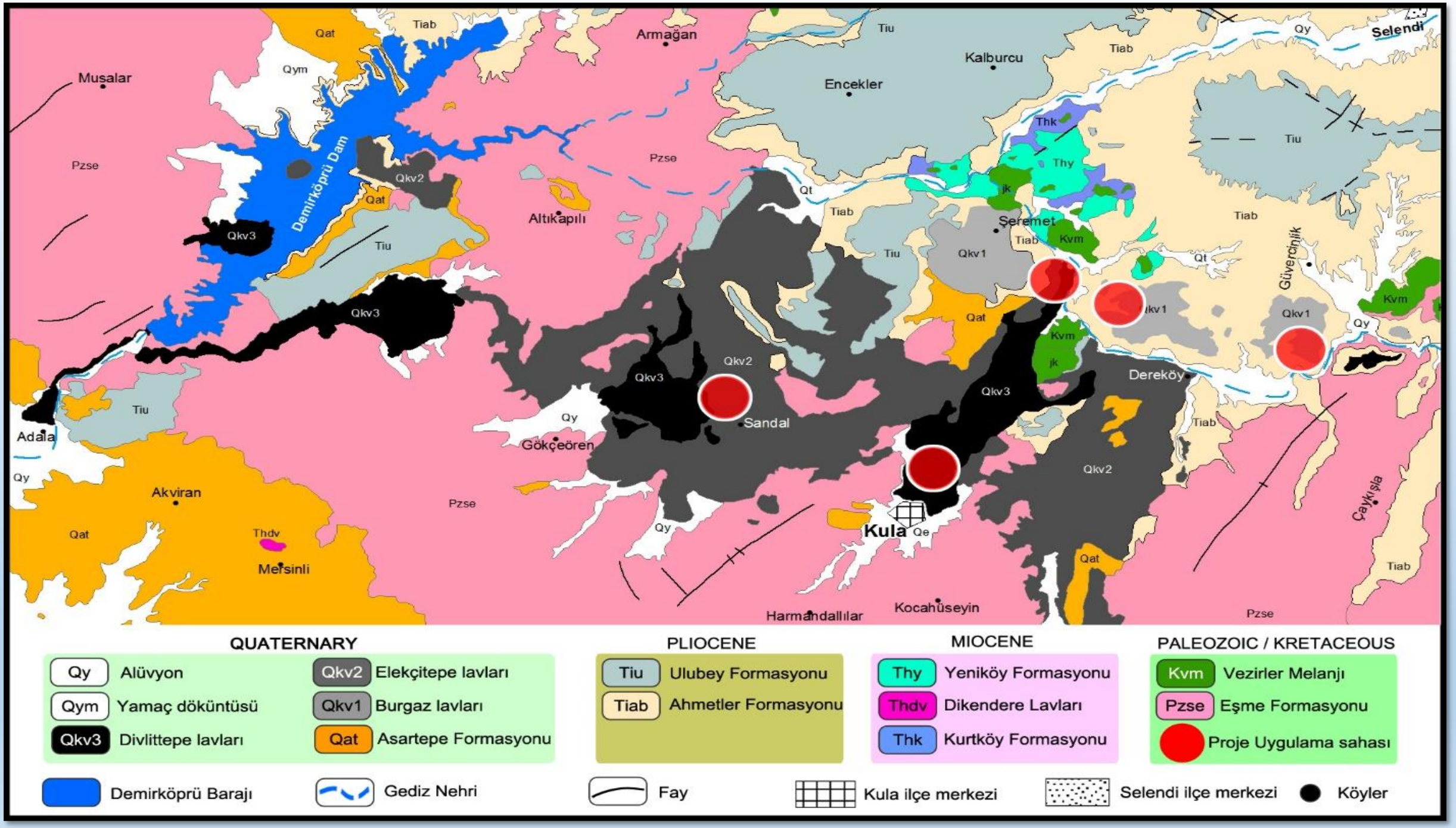
As of September 2013, Kula has been recognized as the first Turkish Geopark by Global Geoparks Network.

Kula Geopark, is located within the administrative territory of the Kula and Salihli districts of Manisa Province in the central part of the Gediz graben in the Aegean Region, on the western part of the Inner West Anatolian Plateau.

The Kula Geopark covers a total area of 2,320 km^2

VOLCANO CONES

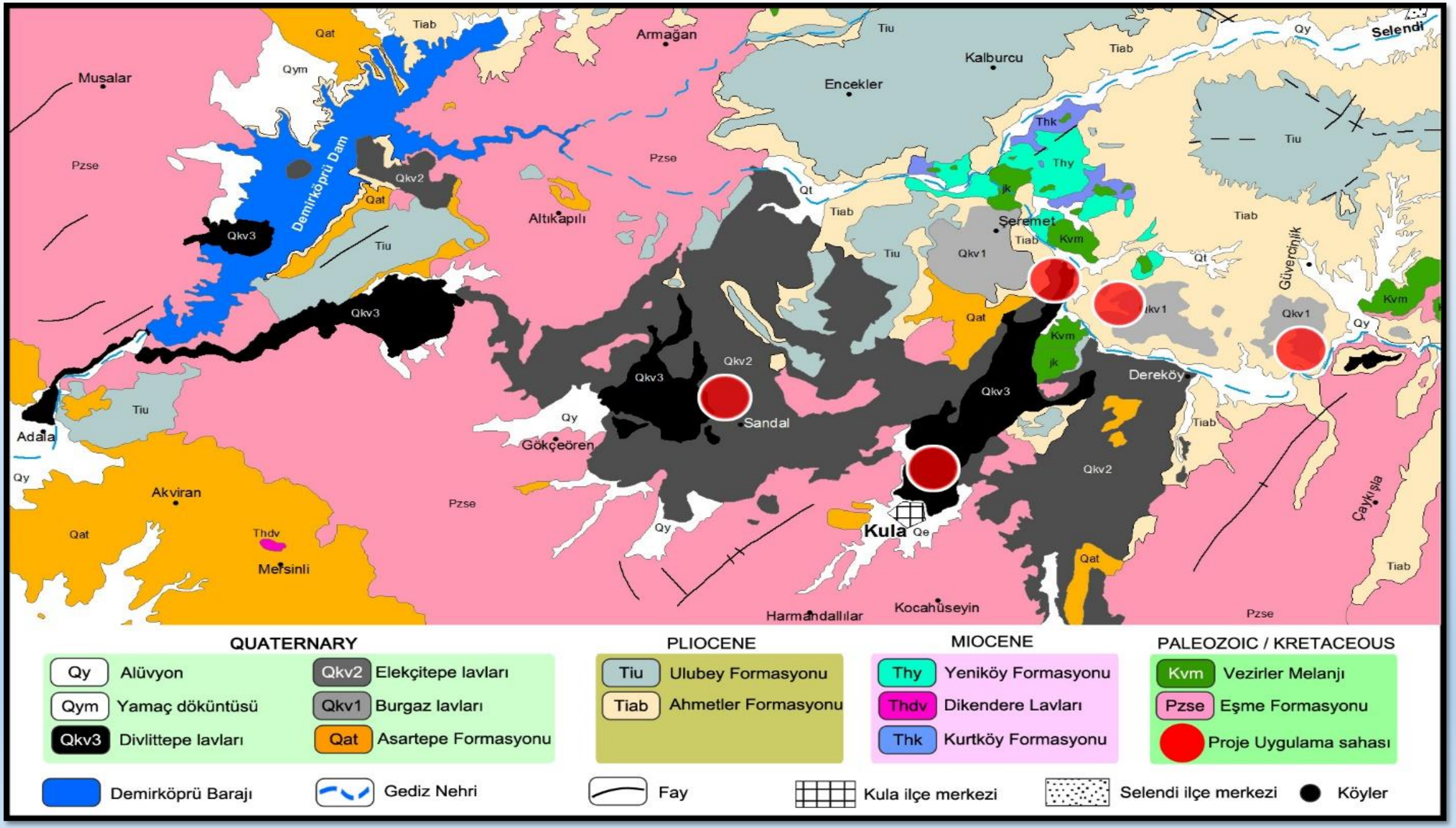
LAV CURRENTS


Musalar
Armağan
Kalburcu
Encekler
Selendi
Demirköprü Dam
Altıkapılı
Şeremet
Güvercinlik
Dereköy
Sandal
Gökçeören
Adala
Akviran
Mersinli
Kula
Çaykışla
Harmandallılar
Kocahüseyin
Qat
Qym
Tiab
Tiu
Qkv1
Qkv2
Qkv3
Qy
Qt
Thk
Thy
jk
Kvm
Pzse
Thdv
Qe
QUATERNARY
Qy Alüvyon
Qym Yamaç döküntüsü
Qkv3 Divlittepe lavları
Qkv2 Elekçitepe lavları
Qkv1 Burgaz lavları
Qat Asartepe Formasyonu
PLIOCENE
Tiu Ulubey Formasyonu
Tiab Ahmetler Formasyonu
MIOCENE
Thy Yeniköy Formasyonu
Thdv Dikendere Lavları
Thk Kurtköy Formasyonu
PALEOZOIC / KRETACEOUS
Kvm Vezirler Melanjı
Pzse Eşme Formasyonu
Proje Uygulama sahası
Demirköprü Barajı
Gediz Nehri
Fay
Kula ilçe merkezi
Selendi ilçe merkezi
Köyler

In the geopark, volcanoes cones does not exceed 150 meters.

In this sense, Kula Geopark can be visited with very little risk and effort. It is very suitable for geotourism and geoeducation activities.

Kula Geopark represents a complex geology and geomorphology due to the ongoing active tectonic regime in the Aegean extensional province. The Geopark contains evidence from more than 200 million years of earth history, from Palaeozoic metamorphic rocks to prehistoric volcanic eruptions. With these characteristics, the Geopark area exhibits a very rich geological diversity.


Musalar
Armağan
Kalburcu
Encekler
Selendi
Demirköprü Dam
Altıkapılı
Şeremet
Güvercinlik
Dereköy
Sandal
Gökçeören
Adala
Akviran
Mersinli
Kula
Çaykışla
Harmandallılar
Kocahüseyin
Qat
Qym
Tiab
Tiu
Qkv1
Qkv2
Qkv3
Qy
Qt
Thk
Thy
jk
Kvm
Pzse
Thdv
Qe
QUATERNARY
Qy Alüvyon
Qym Yamaç döküntüsü
Qkv3 Divlittepe lavları
Qkv2 Elekçitepe lavları
Qkv1 Burgaz lavları
Qat Asartepe Formasyonu
PLIOCENE
Tiu Ulubey Formasyonu
Tiab Ahmetler Formasyonu
MIOCENE
Thy Yeniköy Formasyonu
Thdv Dikendere Lavları
Thk Kurtköy Formasyonu
PALEOZOIC / KRETACEOUS
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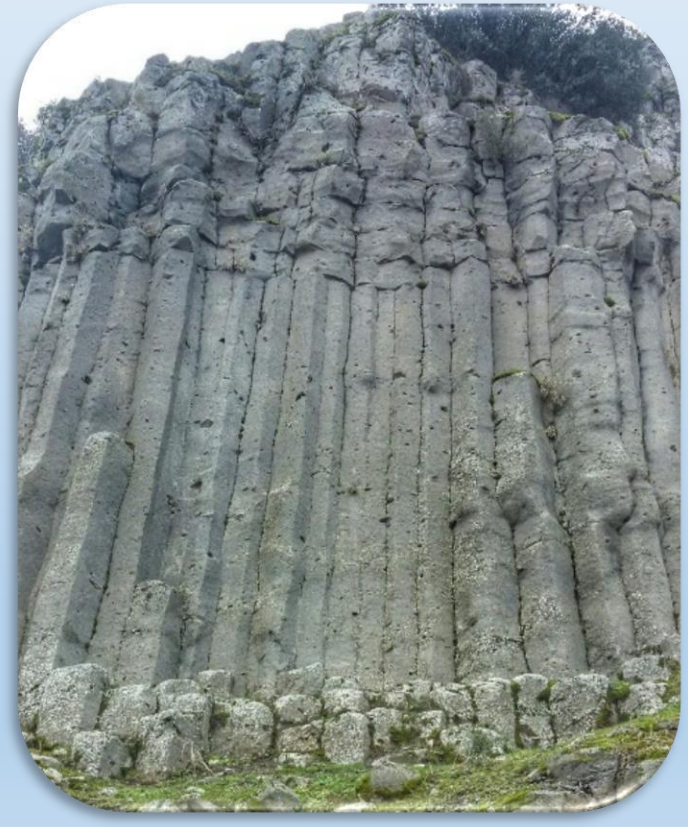
Kula ilçe merkezi
Selendi ilçe merkezi
Köyler

The Kula Geopark, one of the youngest volcanic region of Turkey, is *the most important geotourism area* in Turkey due to its *natural, geologic, cultural and archaeological richness.* Kula Geopark is the first and the unique example of a UNESCO registered geopark in Turkey.



BASALT COLUMNS

FAIRY CHIMNEYS

HUMAN FOOTPRINTS


KULA JEOPARKI
Yollar
1:50,000

In addition to its unique natural and geological heritage, Kula Geopark has a rich historical, cultural, archaeological and paleontological heritage intertwined with the geological heritage.

Kula hosts one of the most characteristic and best preserved examples of Ottoman architecture in Turkey.

The Kula buildings are the unspoiled typical examples of our *old city settlement* in terms of architecture . Because of this, Kula are labeled as city of monument. Conservation of Kula and the like is of great importance in terms of urban life and cultural sustainability.

We wait everybody for the KULA GLOBAL GEOPARK's experiences to TURKEY ☺

THANK YOU FOR YOUR ATTENTION…

SUNRAISE

UNIVERSITÄT SALZBURG

SOCIETY FOR URBAN ECOLOGY

SURE

Co-funded by the
Erasmus+ Programme
of the European Union

Erasmus+

SUNRAISE – SURE
Summer School URBAN + MOUNTAINS
15th – 21th of July 2019
Salzburg, Austria


KULA JEOPARKI

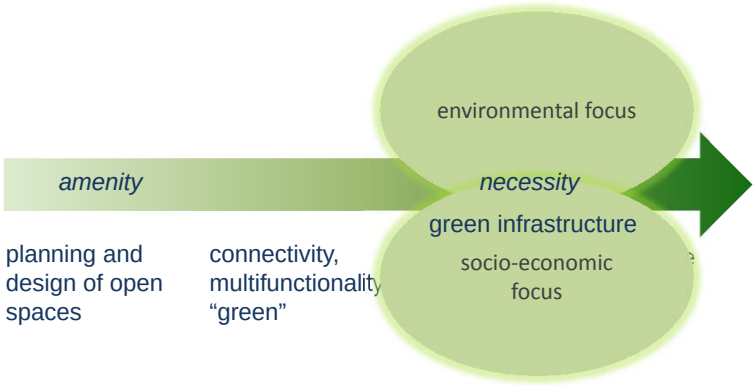
Urban trees and urban climate

Beyond indicators: urban trees and their ecosystem services

SUNRAISE – SURE Summer School
URBAN + MOUNTAINS 7th – 14th of July 2019
Salzburg, Austria

Angela Hof
Associate Professor
University of Salzburg
Department of Geography and Geology

Urban trees in context



2

From ESS to NBS in urban planning

- The concept of „ecosystem services“ has become popular in planning policy because of its emphasis on the human benefits of ecological functions (Wright 2011, p. 1010)
  - *Urban authorities may have limited capacity to deal with the complexity of ecosystem services (Kronenberg 2015, p. 219)*
- Green infrastructure is implicitly socio-economic, identified as a tool to deliver „ecosystem services“ in planning policy (Wright 2011, p. 1010)
  - *Green infrastructure is a nature-based solution to achieve desired outcomes*
  - Research typically provides normative suggestions on how to manage urban ecosystems and ecosystem services (Wright 2011, p. 1013)
  - *Practitioners may choose to deliver those functions which provide greater certainty of economic return and environmental functions drop out of the equation (Wright 2011, p. 1014)*

3

Citree: planning software for tree selection in urban areas

Following slides: Own data analysis with Ruhr metropolis street cadastre data, Citree software (TU Dresden, https://141.30.134.137/citree/) and the list of 50 ‘street trees for the future’ by Roloff (2013) and Wittig et al. (2012) - *preliminary results*

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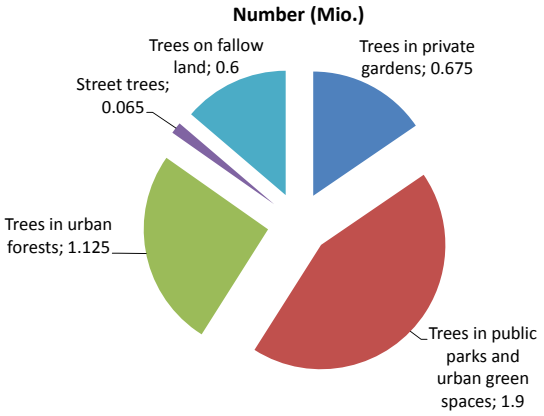
See: TU Dresden, https://141.30.134.137/citree/

Introduction – the importance of public trees in the urban tree stock



Source: own elaboration from data in Roloff, Andreas (2016): Urban Tree Management: For the Sustainable Development of Green Cities; Roloff, Andreas (2013): Stadt- und Straßenbäume der Zukunft - welche Arten sind geeignet? Forstwiss. Beiträge Tharandt Beiheft (14), 173–187.

6

Current tree stock versus 50 “street trees for the future” (Roloff 2013)

- Can retrofitting enhance urban ecosystems - and their provision of urban ecosystem services and urban nature-based solutions?
- 15% of current street tree stock is made up of tree species on the list of 50 “street trees for the future” (Roloff 2013)
- Tree species considered to have unfavourable future prognosis (Roloff 2013): 54%
- Tree species considered to have low isoprene emissions and high drought stress tolerance (Wittig et al. 2012): 8%

7

Material and methods
Results

Scholz, T.; Hof, A.; Schmitt, T. (2018): Cooling Effects and Regulating Ecosystem Services provided by Urban Trees – Novel Analysis Approaches using Urban Tree Cadastre Data. Sustainability 10 (3) 712. doi:10.3390/su10030712

Matching i-Tree data requirements with the tree cadastre of Duisburg

Data requirement	Tree cadastre
Species	✓
Landuse	✓
DBH [cm]	✓
Crown Width [m]	✓
Crown Missing [%]	(✓)
Crown Dieback [%]	(✓)
Crown Base [m]	x
Tree Height [m]	x
Crown Light Exposure [0-5]	x

- Usually, not all information for an i-Tree analysis is included in urban tree cadastres
- Filling the data gaps with fieldwork for 50,000 trees is cost-intensive and time-consuming
- Need to estimate missing data with (geo-) statistical methods

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Regulating ecosystem services provided by public urban trees

Regulating ecosystem services of 50,000 urban trees in Duisburg

Ecosystem service	Sum for urban trees	Urban Emissions, Precipitation, direct and thermal energy receiving	Percentage
C-Storage	21,749 t	-	-
CO_2-Sequestration	708 t y^{-1}	355,383 t y^{-1}	0.2%
Pollutants removal (without O_3)	16 t y^{-1}	626 t y^{-1}	2.6%
NO_2	6 t y^{-1}	266 t y^{-1}	2.3%
SO_2	3 t y^{-1}	316 t y^{-1}	0.9%
PM_{10} + $PM_{2.5}$	7 t y^{-1}	44 t y^{-1}	15.9%
O_3	11 t y^{-1}	-	-
Interception	69,832 m^3 y^{-1}	2,382,715 m^3 y^{-1}	2.9%
Energy reduction	1,767 MW	3,054 MW	57.9%

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Source: Scholz, Hof & Schmitt 2018

Tree species and their regulating ecosystem services – results-based ranking

1. Classification

Class	C-Storage [kg]	CO_2-Sequestration [kg a^{-1}]	Filtering [g a^{-1}]	Shading [m^2]	Interception [m^3 a^{-1}]
Very high (4)	250-1,250	20-40	500-1,100	20-50	1-3
High (3)	150-249	10-19	250-499	12-19	0,5-0,9
Medium (2)	85-149	5-9	100-249	6-11	0.25-0.4
Low (1)	< 85	< 5	< 100	< 6	< 0.25

2. Ranking – qualitative assessment of the current public urban tree stock

Tree species	C-Storage	C-Sequestration	Filtering	Shading	Interception
Platanus x acerifolia	4	4	4	4	4
Aesculus hippocastanum	4	4	4	4	4
Robinia pseudoacacia	4	4	3	3	4
Tilia cordata	4	3	4	3	4
Corylus colurna	2	2	2	2	3
Sorbus aria	2	2	2	2	2

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Source: Scholz, Hof & Schmitt 2016

Wie lassen sich aus Baumkatasterdaten klimatische Regulationsleistungen ableiten?

http://www.esp-de.de/baumkatasterdaten-klimatische-regulationsleistungen/

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Outlook
Work in progress

Urban trees as climate messengers

A Sparkling Science Project

Federal Ministry
Education, Science
and Research

Urban trees as climate messengers

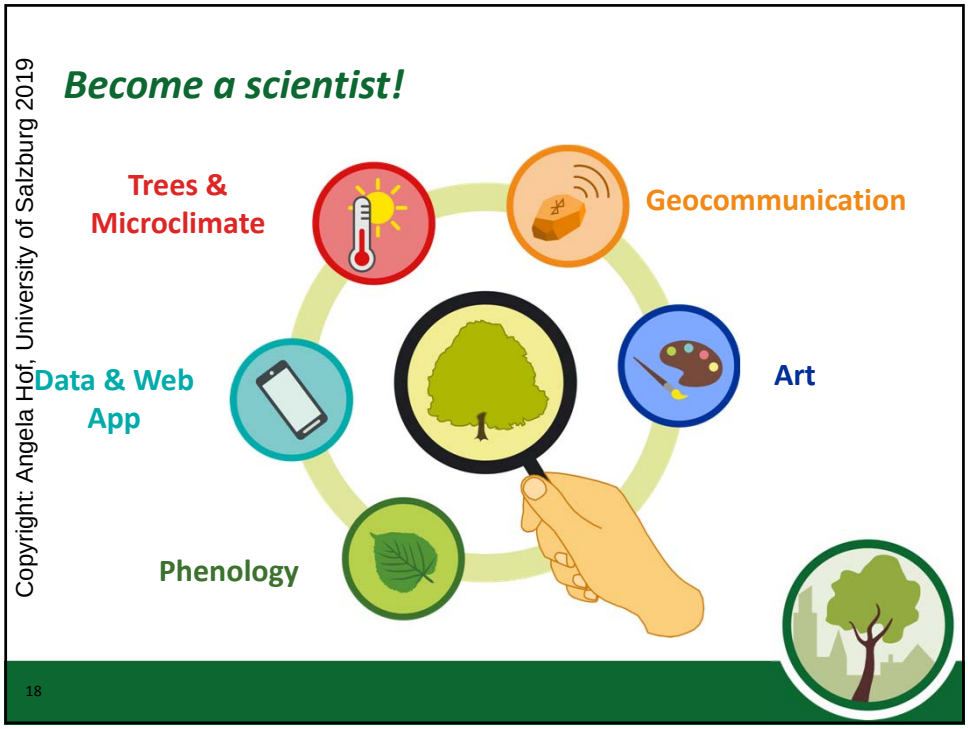
Urban trees as climate messengers

A Sparkling Science Project

Funding in the Sparkling Science research programme of the Federal Ministry of Science, Research and Economy (BMWFW), Austria, 6th call, project "Urban trees as climate messengers", project number SPA 06/005.

Research question

- How do urban trees affect the urban climate?
- How does the urban climate affect urban trees?
- What does this mean for our future and the future of the trees?


Become a scientist!
Trees & Microclimate
Geocommunication
Data & Web App
Art
Phenology
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18


More-than-GREEN-Urban tree
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Ecosystem services of trees

CO_2

Water + Carbon dioxide + light

Energy from ambient heat

Deposition of dust

up to 12.000 dust particles per m³ in the city

→ **Improvement of air quality**

Oxygen emission

about 1m³ per day

Oxygen + Glucose + Water

Evaporation

Up to 400 l in one day

Cooling

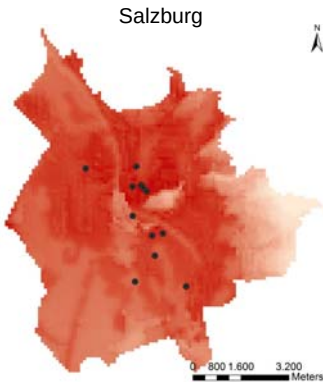
Climate regulating Ecosystem services

Shading

20

Phenology and microclimate monitoring

- 6 tree species (Aesculus, Acer, Corylus, Ginkgo, Paulownia, Platanus, Tilia, …)
- 73 trees
- 53 iButton microclimate sensors, including reference measurements



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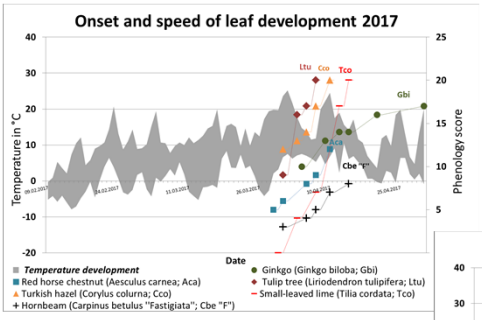
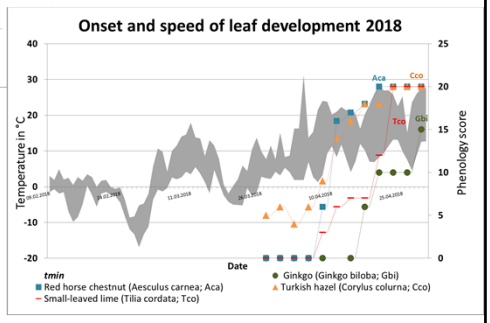
First results: Phenology monitoring





Copyright: Angela Hof, University of Salzburg 2019

Microclimate measurements

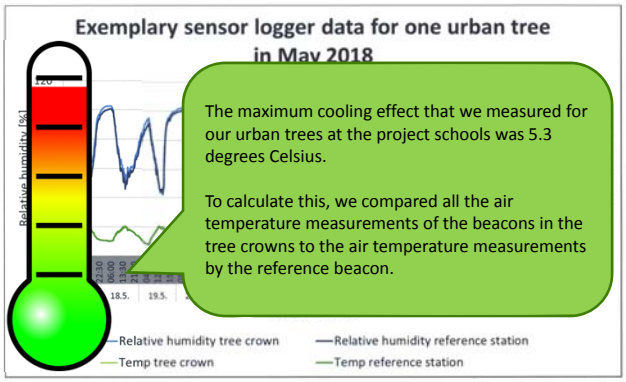
Long term, continuous measurements

- **Temperature and relative humidity** (15min intervall)
  -> Sensors **„Beacons“** (temperature, humidity, dew point, bluetooth sensor beacon and logger, Blue Maestro Limited, London, United Kingdom)
  -> Sensors **„iButtons“** (Hygrochron Temp/Rel. humidity Logger - 8KB memory – DS1923-F5, Maxim Integrated, San Jose, USA)

Field measurement campaigns

- **Surface temperature of shaded and sun-exposed sites**
  -> Infrared-Radiometer (SI-121, Apogee Instruments, Utah, USA)
- **Messungen zum Thermischen Komfort**
  -> Black-Globe-Thermometer (Heat stress measurement instrument PCE-WB 20SD, PCE Instruments, Meschede, Deutschland)

Preliminary results: Cooling effect



For this tree, the mean difference in temperature was -0.3°C, and the mean difference in relative humidity was 2.7%. During daytime, differences were –0.6 °C and 2.7%, respectively.

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For more detailed results, please read and cite our paper ;-)

Stanley, C.H.; Helletsgruber, C. & Hof, A. Mutual influences of urban microclimate and urban trees: an investigation of phenology and cooling capacity. *Forests* 2019, *10*, 533.

Concluding remarks

- Based on our results, we
  - Contribute to a better understanding of the dynamics of urban ecosystem services of public urban trees & we address a current research gap
  - Develop innovative approaches for inventory and assessment of public urban trees as key element of urban green infrastructure
  - Deliver advice for practitioners and urban planners: how to make cities more resilient to climate change by strategically planning and growing the urban tree stock

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Urban trees as climate messengers

Stadtbäume als Klimabotschafter

Ein Sparkling Science Projekt

Wissenschaft ruft Schule
Schule ruft Wissenschaft

Bundesministerium Bildung, Wissenschaft und Forschung

Funding in the Sparkling Science research programme of the Federal Ministry of Science, Research and Economy (BMWFW), Austria, 6th call, project "Urban trees as climate messengers", project number SPA 06/005.

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Thank you for your attention!

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Unsere Website!

http://stadt-baum-klima.sbg.ac.at/

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