

→ EARTH OBSERVATION FOR SUSTAINABLE DEVELOPMENT

Climate Resilience

Habitat Quality Assessment



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2. What to measure?
3. How to measure Habitat Quality?
 - A. Essential Biodiversity Variables
 - B. Mapping ecosystem services
4. Use case

Why measure Habitat Quality?



Assessing habitat quality is one particular way to provide a key message on measure the overall suitability of a given area and its capacity to support healthy ecosystems.

Habitat quality plays a key role in:

- Measuring the status of ecosystems
- Facilitating the development ecosystem service indicators
- Supporting restoration prioritization policies
- Ensuring no net loss of biodiversity and provisioning of related ecosystem services.

Habitat quality assessment should be able to enter at several points into the decision- and policy- making process to limit the negative impacts of anthropogenic activities in natural ecosystems.

Habitat Quality components:

- Biotic factors (species composition, species functionality, structure of community/population, succession stage)

number, abundance, diversity, demographic rates, red list species, productivity, functional and behavioral threats, diseases, dominance, complexity, age classes

- Environmental variables/attributes (soil characteristics, water characteristics, micro-climate parameters, atmospheric parameters)

nutrient content, soil moisture, chemical composition, erosion and sedimentation dynamics, temperature, air humidity, nitrogen deposition

- Spatial/Landscape characteristics (habitat structure and configuration)

patch size, shape, spatial configuration, connectedness, barriers, core/edge ratio, boundary type, diversity

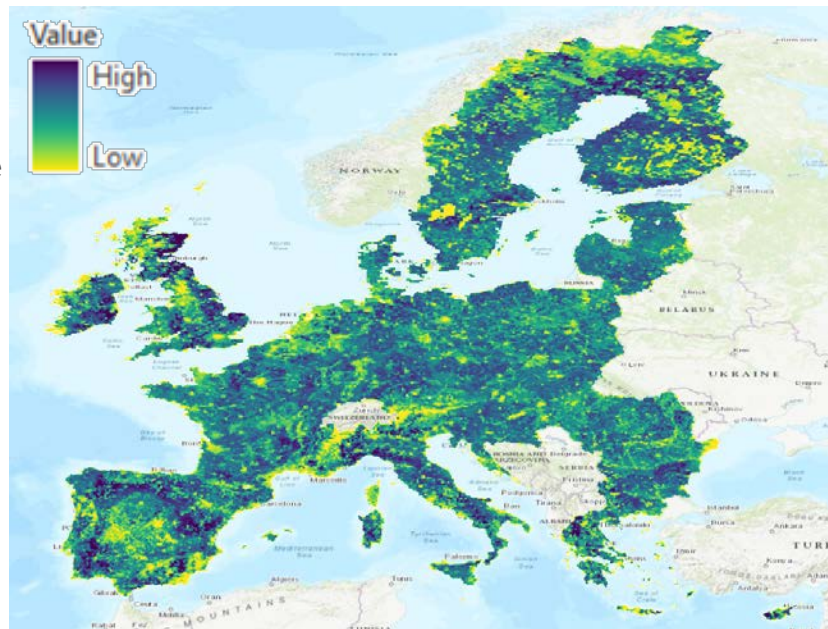
What to measure?

Habitat Quality Indicator:

Source: European Commission, Joint Research Centre

Inputs:

- The EBCC Atlas of European breeding birds
- Environmental variables
 - ✓ Climatic variables
 - ✓ Land uses
 - ✓ Distance to artificial areas
 - ✓ Landscape diversity
- Species distribution models per ecosystem type (artificial, arable, permanent crops, pastures, forests, wetlands)



What to measure?



The **InVEST habitat quality model** estimates which habitat type reflects natural conditions the best. In InVEST, habitat quality is a function of three factors:

1. The suitability of each LU/LC type for providing habitat for biodiversity

LU/LC type obtained from Satellite image classification (e.g. MODIS, Landsat, Sentinel-2) or EO products provided by Space organization (such as the Copernicus Land Monitoring Service - CLMS)

2. The different anthropogenic threats

Treat parameters are determined from expert knowledge and literature review/assessment (e.g. Urbanization, Agriculture, Road network, Susceptibility to fire events)

3. Relative sensitivity of each habitat type to each threat

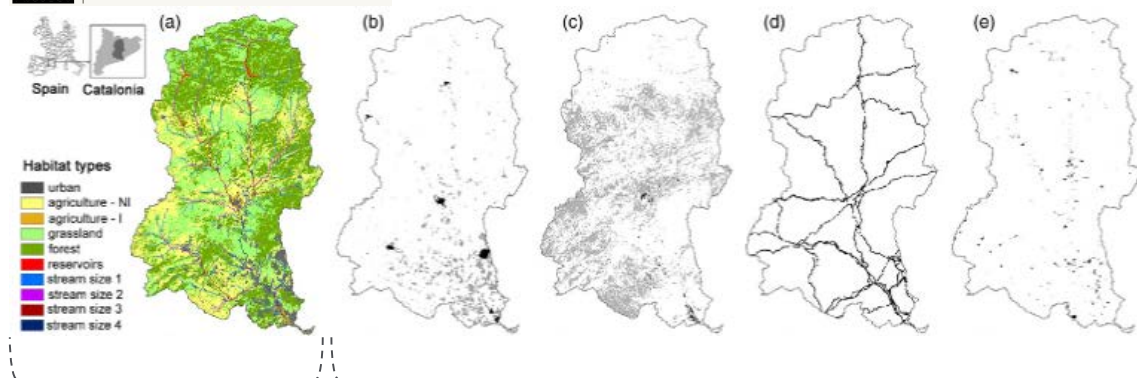
Also determined from expert knowledge and literature review/assessment



NATURAL CAPITAL PROJECT

What to measure?

NATURAL CAPITAL PROJECT



Habitat types

Threat parameters

Habitat sensitivity
to each parameter

Habitat type	H_j [0-1]	Relative sensitivity of habitat types to threats (S_{jp})			
		Urbanization	Agriculture	Roads	Mining
Urban	0.15	0.01	0.16	0.10	0.19
Ag. non-irrigated	0.55	0.72	0.01	0.58	0.63
Ag. irrigated	0.40	0.69	0.03	0.59	0.65
Grass/Shrubland	0.72	0.75	0.67	0.70	0.68
Forest	0.93	0.85	0.70	0.78	0.72
Reservoirs	0.33	0.42	0.61	0.29	0.64

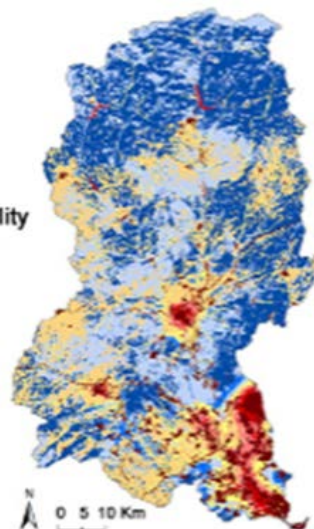


Current
habitat quality

lower quality



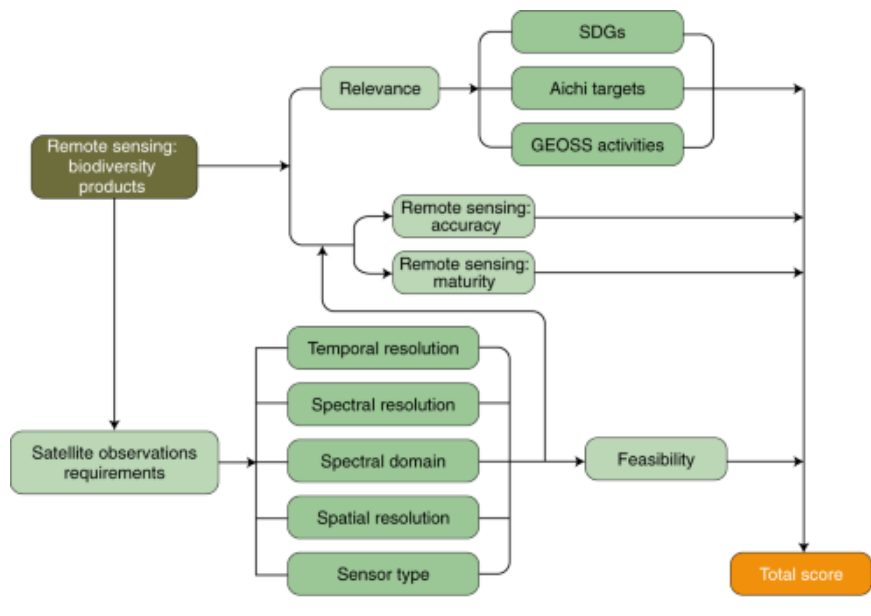
higher quality



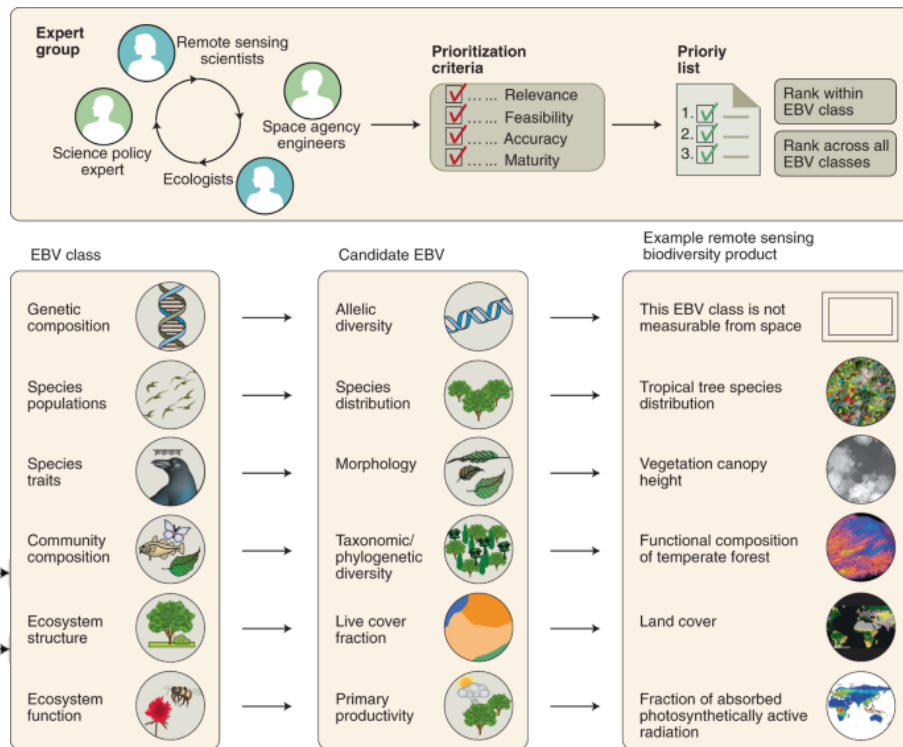
Terrado et al. (2016). Model development for the assessment of terrestrial and aquatic habitat quality in conservation planning Sci. Total Environ., 540, 63-70.

How to measure Habitat Quality?

Essential Biodiversity Variables



Skidmore, A.K., Coops, N.C., Neinavaz, E., ... Wingate, V. (2021). **Priority list of biodiversity metrics to observe from space.** *Nature Ecology & Evolution*, 1-11.



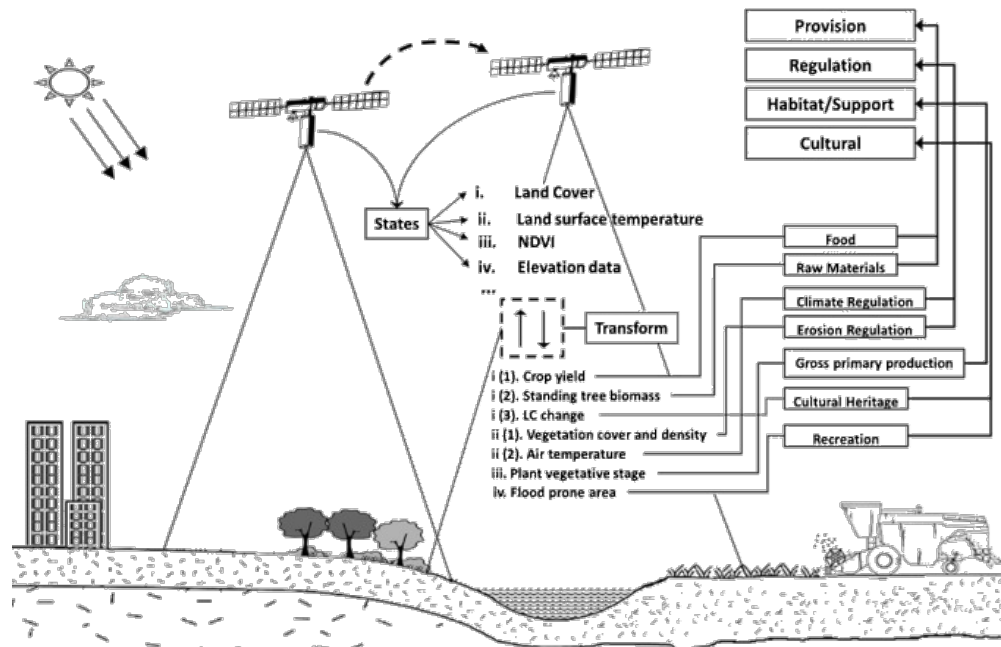
How to measure Habitat Quality?

Mapping ecosystem services

EO enables spatially continuous, regular, and repeatable observations over large areas, ensuring systematic and continuous observations.

EO provides essential information on the functioning of ecosystems and on the drivers of environmental change.

Terrestrial ecosystem variables derived from remote sensing can play a key role in model development.



Association between drivers and pressures and ecosystem services (de Araujo Barbosa et al., 2015).

Workflow

1. Explore the needs of the study area (consult with end users/stakeholders)
2. Identify important ecosystem services (incl. habitat quality)
3. Collect EO data and perform any necessary transformations
4. Modelling and mapping EO-based biodiversity and ecosystem services indicators
5. Habitat quality assessment
6. Results' extraction based on the previously defined needs

Identify study area characteristics

Ex. Kyrgyz Republic:

1. Grassland dominated ecosystems facilitate the protection of mountainsides.
2. Pastures are used for grazing and hay fields.
3. Forest ecosystems play an important role in maintaining environmental balance, strengthening slopes, regulation of runoffs and clearing of the air.
4. Forest communities provide important recreational and aesthetic, cognitive, educational functions, and are sources of non-forest timber products (mushrooms, berries, nuts).
5. The use of wood for construction purposes as well as for house heating causes a significant damage to forest ecosystems.
6. Aquatic ecosystems play an important role in the provision of fresh water resources, recreational activities, and aquatic biodiversity.

Define a list of important ecosystem services

Provisioning services

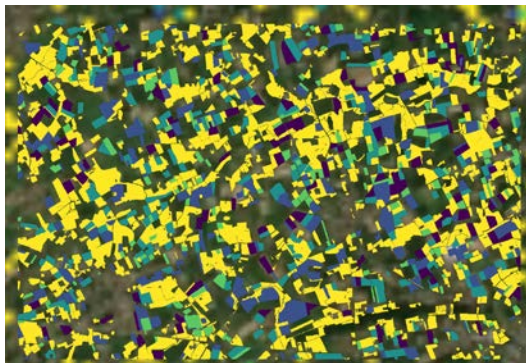
- Biomass provision (crops or reared animals)
- Water provision
- Raw materials

Regulating and Maintenance services

- Erosion prevention
- Climate regulation
- Air quality regulation
- Lifecycle maintenance
- Habitat quality

Cultural services

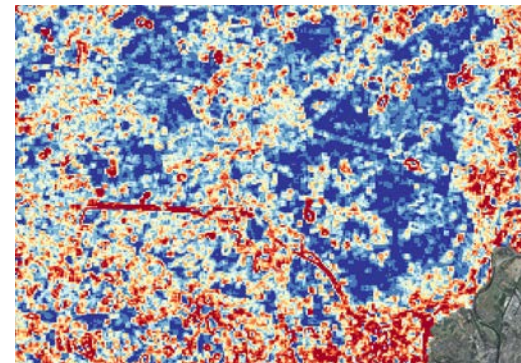
- Recreation potential
- Aesthetic quality



Nutrition biomass example



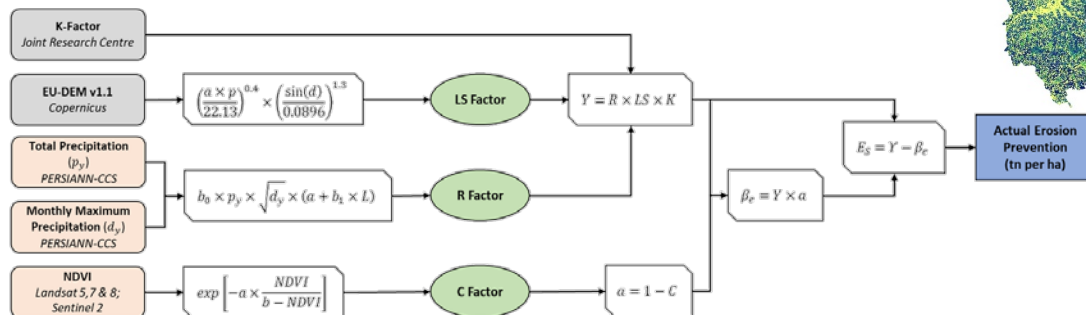
Erosion prevention example



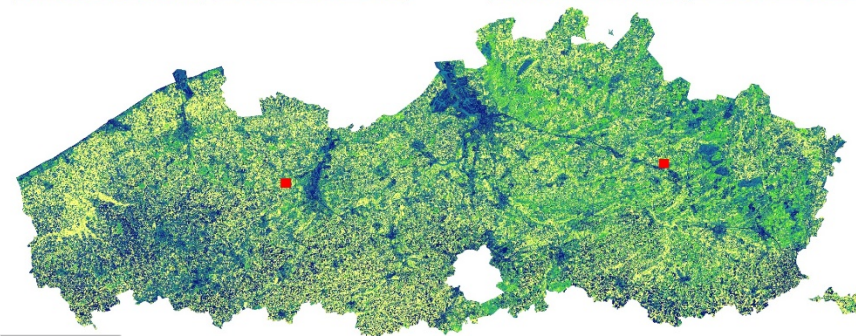
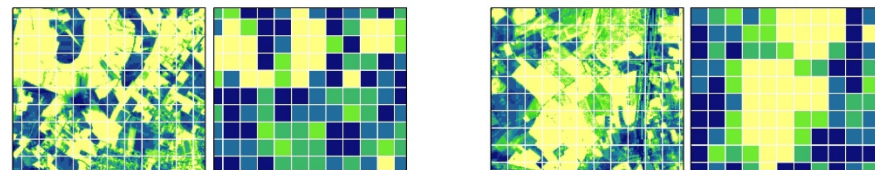
Recreation potential example

Ecosystem services mapping

Datasets	Unit	Source
Soil Erodibility (K- Factor)	500m	Joint Research Centre
EU-DEM v1.1	25m	Copernicus Land Monitoring
NDVI	10-30m	USGS & Copernicus
Total Precipitation	4km	CHRS
Maximum Monthly Precipitation	4km	CHRS



Erosion Prevention



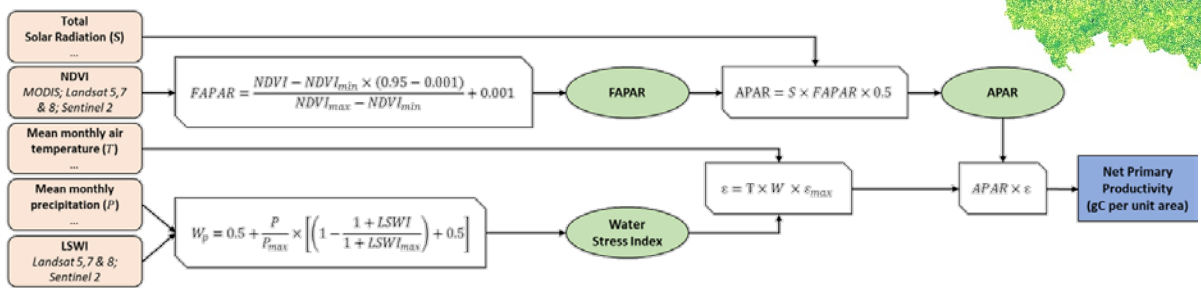
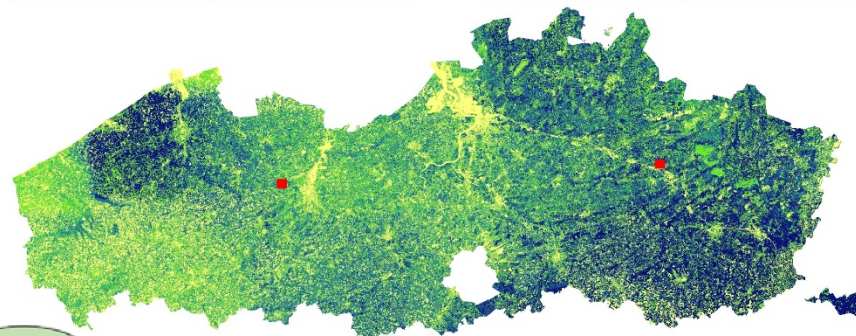
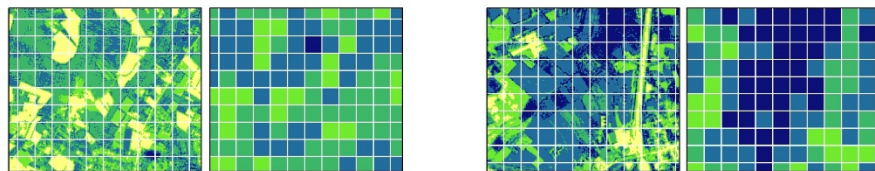
ES Supply
HIGH LOW

0 15 30 60 Km
1 = 900,000

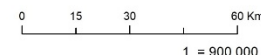
Ecosystem services mapping

Climate Regulation

Datasets	Unit	Source and description
NDVI	10-30m	USGS & Copernicus
LSWI	10-30m	USGS & Copernicus
Mean Monthly Temperature	9km	ERA5
Mean Monthly Precipitation	4km	CHRS



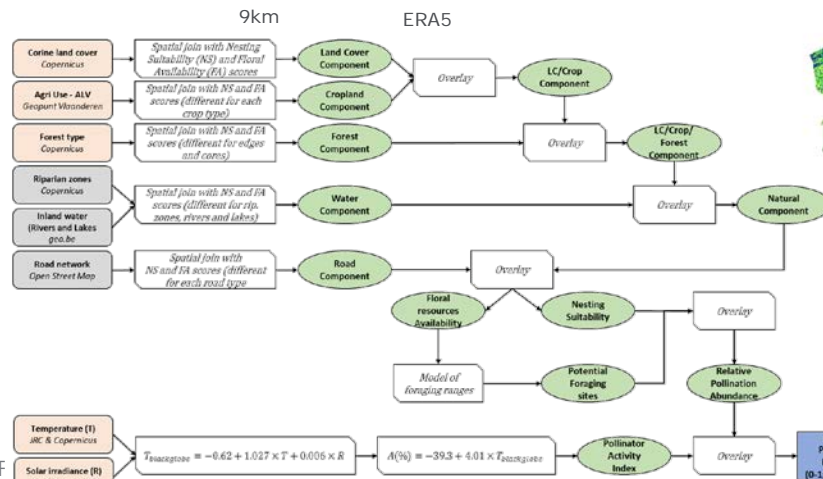
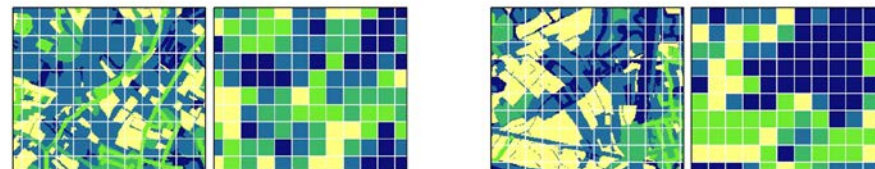
ES Supply
HIGH LOW



Ecosystem services mapping

Datasets	Unit	Source and description
Corine Land Use / Cover	25ha	Copernicus Land Monitoring
Agricultural Use - ALV	parcels	Agricultural Land Use
Forest type	10m	Copernicus Land Monitoring
Riparian zones	0.5ha; 10m	Copernicus Land Monitoring
Inland water		Rivers and lakes
Road network		Open Street Map
Floral availability (FA) and Nesting suitability (NS)	Score (0-1)	FA and NS per ecosystem feature
Solar irradiance		
Temperature		

Pollination Potential

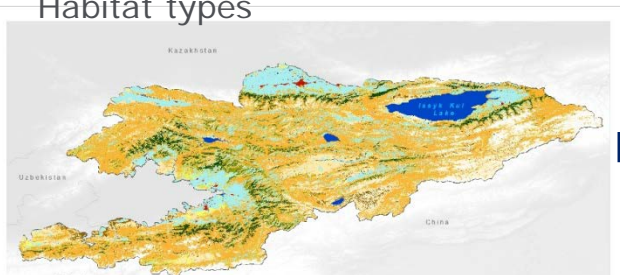


ES Supply
HIGH LOW

0 15 30 60 Km
1 = 900.000

Habitat Quality Assessment

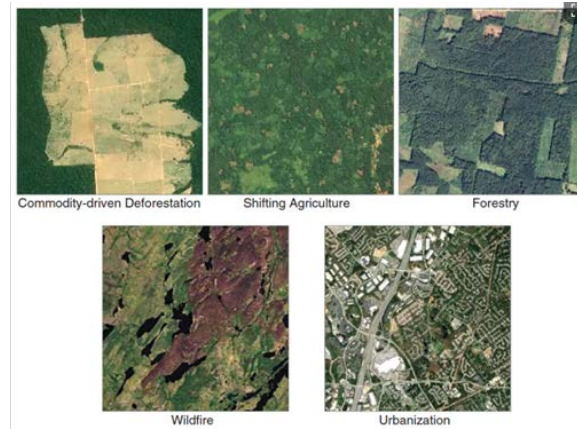
Habitat types



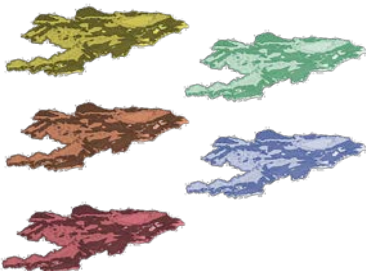
Habitat
Quality



Threat layers

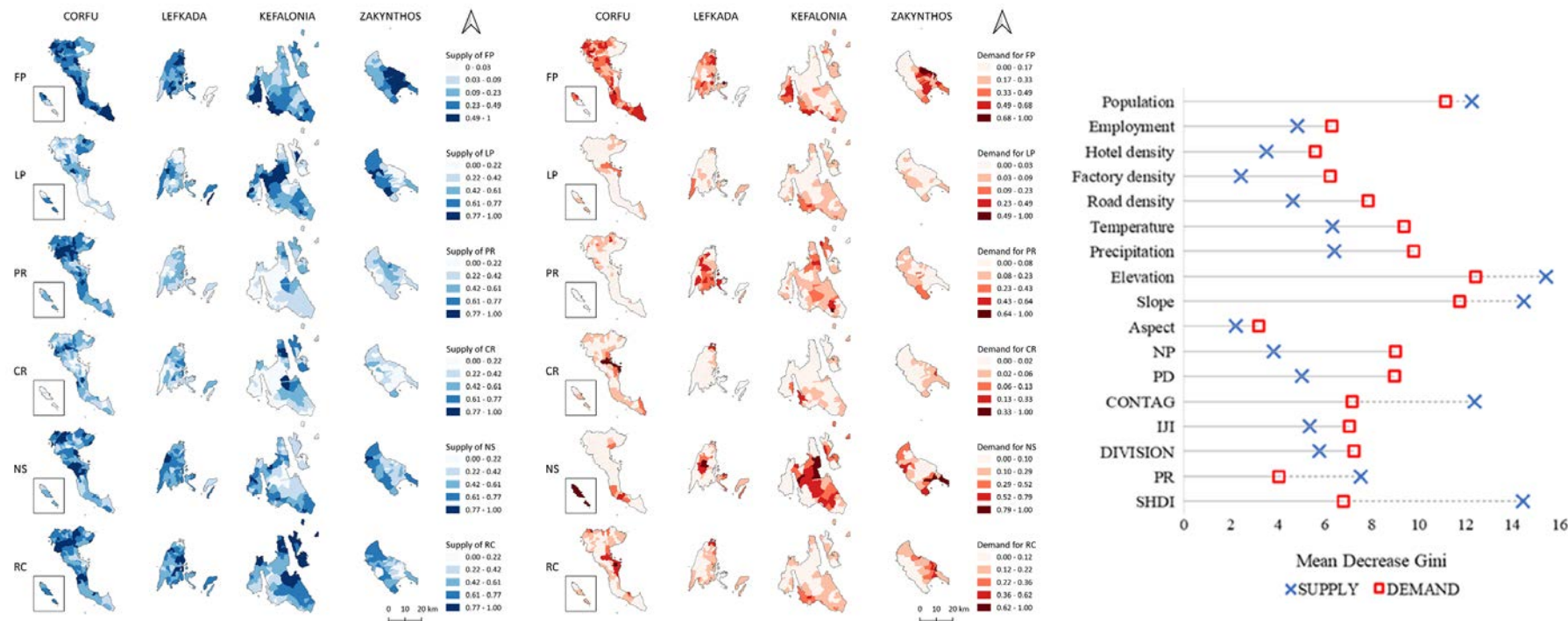


Ecosystem services



Total ecosystem service indicator





FP: food provision; LP: livestock provision; PR: Plant-based resources;
CR: climate regulation; NS: maintenance of nursery populations and habitats; RC: recreation

