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Title:

Ecosystem services accounting for ecosystem restoration, management, and planning.

Outcomes of the FAO-JRC initiative. Part I - the conceptual scheme

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Questions for the London Group

1. The assessment of the ES overuse and unmet demand represents complementary information with respect to the official SUT. Do you find any conceptual/methodological issues that need to be fixed in order to be in line with the mainframe acknowledged in the adopted SEEA EA standard?
2. Do you agree with the ES types that are proposed?
3. What are the main obstacles you see for the implementation of this approach?
4. What are other possible uses you foresee once the final outcomes will be available?

1. Introduction

Ecosystem services are flows that connect ecosystems to the economy and society. Ecosystem services directly depend on the ecological status and condition of ecosystems: the more degraded the ecosystem, the lower the number and extend of services provided. It is important to understand where and how to act to properly maintain and restore the capacity of ecosystems to provide services. To address this need can spin up development in a sustainable framework.

The approach developed through the Knowledge Innovation Project on an Integrated system for Natural Capital Accounting (KIP INCA), address this issue. INCA was set by the European Commission (including Eurostat, Joint Research Centre (JRC), and the European Commission Directorates (DG) on Environment, and on Research and Innovation) and the European Environment Agency to design and implement an integrated accounting system for ecosystems and their services in the EU. INCA is compliant with the SEEA for Ecosystem Services statistical framework and its Technical Recommendations.

The FAO has developed the System for Environmental economic accounting for Agriculture, Forestry and Fisheries (SEEA AFF), which contributes to the overall SEEA accounting platform and has been endorsed by the UN Statistical Commission as methodological document for bringing together economy and environment statistics, in support of natural capital accounting, ecosystems services evaluation, biodiversity assessment and SDG monitoring and reporting for ISIC A activities. As such, it has been already applied in several FAO-GEF projects, including Sudan and Afghanistan, reinforcing national and local assessment of natural resources, biodiversity and policy planning.

2. Part I : defining the conceptual scheme

Ecosystem Accounts is composed of several modules. Among them, we focus on ecosystem services accounts, and specifically on Supply and Use Tables (SUT). As already stated, INCA approach is compliant with the SEEA EA in the way ES actual flow is reported within SUT. However, INCA proposes a conceptual framework behind the assessment of ES actual flow that considers (i) the identification of ES potential and demand, (ii) the types and typologies of ES.

INCA methodology and joint FAO-JRC implementation

According to INCA, to assess and value the use (i.e. actual flow) of ecosystem services (ES) we need to:

- quantify in physical and monetary terms the “ES potential”, i.e. what ecosystems are able to provide (independently of their use);
- quantify in physical and monetary terms the “ES demand”, i.e. who is going to use the ES (i.e. economic sectors and/or households).

Figure 1 shows that the interaction between ES potential and ES demand generates ES actual flow. The specific identification, assessing and mapping of ES potential and demand allows not only to see and count where they generate where they generate ES actual flow, but also where they mismatch generating unsustainability contexts (Figure 1).

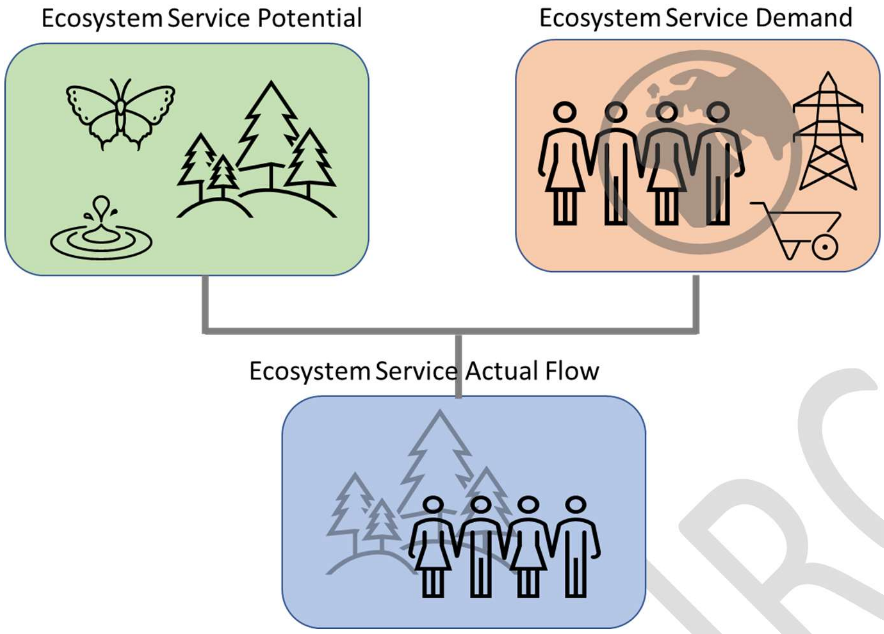


Figure 1 – Visual simplification of the conceptual framework behind ES assessment

ES actual flow occurs when ES potential matches ES demand. In fact, when we face the case ES potential ≥ ES demand (ref. Figure 1 (b) and (d)), the ability of ecosystem to provide the same amount of ES flow is kept unchanged. However, the mismatch ES potential < ES demand may occur for two reasons:

- for those ES where there is a regeneration rates for biomass extraction, and an absorption rates for pollutant removals, a higher demand generates an overuse of the ecosystem service (ref. Figure 2 (a)), that eventually lead to degradation. In this case the major driver of change lies in management practices;
- for all the other ES, a higher ES demand cannot be satisfied when ecosystems providing the services needed are not there. The need from the demand will remain unsatisfied (ref. Figure 2 (c)). In this case the major driver of change lies in land use/ conversion.

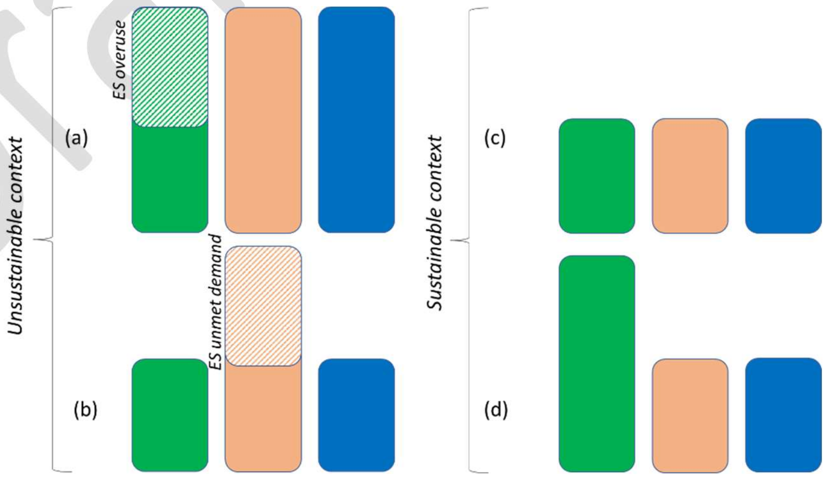
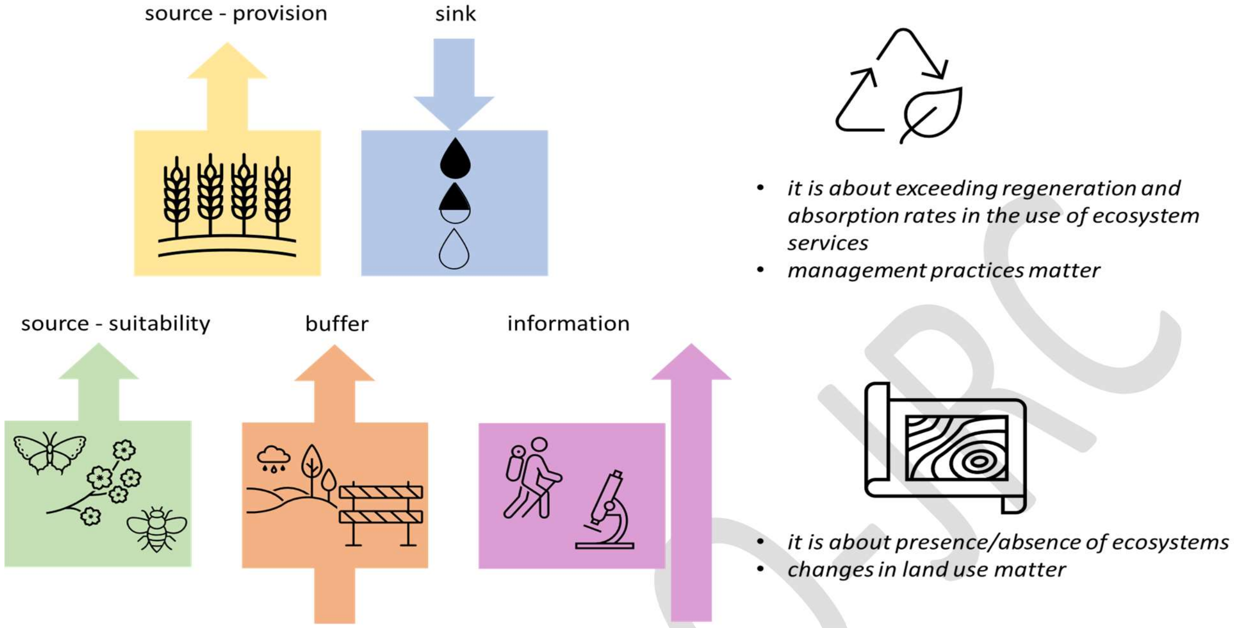


Figure 2 – Match and mismatch between ES potential and ES demand

Unsustainability contexts can happen because ES are overused wrt its sustainability thresholds[1], or because ecosystems providing the needed ES are not there[2] (Figure 2). Unsustainability for some types of ES depends on how they are managed (because there are regeneration and absorption rates) and for other ES depends on land cover and use changes (Figure 3).



Source: adapted from https://www.sciencedirect.com/science/article/pii/S2212041617307246

Figure 3 – Types of ecosystem services

The identification of different ecosystem types is particularly important when (i) identifying the driver of change and (ii) assessing ecosystem capacity.

The driver of change could in fact depend of management practices (e.g: emitting a load of nitrogen into water bodies that exceed the sustainability threshold concerning the eutrophication issue), or the land use (e.g. converting cropland into urban, or forest into cropland). Policy guidelines and strategic directions are clearly very different when addressing one set of issue (sustainable practices) or the other (land use planning planning). About ecosystem capacity, the ability of ecosystems to keep on providing ES in the future must be assessed considering whether overuse is taking place rather than considering actual flows, because actual flows may be unsustainable and this is causing ecosystem degradation; overuse takes place for source-provision and sink services only.

The INCA framework here summarised is the outcome of 5 years of work at the JRC, and the all the models built on this backbone are now becoming a toolkit (i.e. GIS plug-in) that will allow any country to systematically replicate ES accounts.

ES overuse and ES unmet demand are assessed in physical terms in INCA, but it is not currently valued in monetary terms. **Monetary valuation of missed flows of ES would be an important indicator to drive ecosystem restoration initiatives**.

This approach has been applied, in collaboration with FAO, in the Sudan project "Landscape Approach to Riverine Forest Restoration, Biodiversity Conservation and Livelihood Improvement" where, using FAOSTAT

[1] Check the case of water purification at https://www.sciencedirect.com/science/article/pii/S2212041616304545
[2] Check the case of flood control at https://www.sciencedirect.com/science/article/pii/S221204162030084X

data, carbon sequestration quantity and value was computed for Sudan, 2015, and related carbon sequestration map was gathered.

3. What to expect from Part II

The INCA approach could further assess is the monetary value of ES overuse and unmet facilitating policy on ecosystem restoration. The overall objective of this initiative is to propose an ecological-economic measurement system that links the presence of human needs for specific services, with the absence of ecosystems able to provide those services. Ecology underpins this system by using the best available knowledge to model ES potential; economy underpins this system by clearly identifying ES users (i.e. economic sectors, household and global society) and by using economic tools to directly connect with funding instruments.

Considering that ES modelling GIS plug-in tools will be made available (by 2022), the current development of the hands in hands FAO initiative, this system could guarantee systematic assessment and monitoring over time. At the time been JRC is working and validating for Europe the following monetary flows of ES unmet demand, ES overuse and ES missed flow:

- Crop pollination
- Flood control
- CO_2 mitigation
- Habitat and species maintenance
- Soil retention
- Water purification

Once available this information can help addressing the following policy questions:

3.1 Where to restore habitats to have more resilient agri-food systems?

To address this question we need to address ecosystem services such as:

- crop provision, and specifically where ecosystem contribution is almost null (Figure 4);
- crop pollination, and specifically the areas where there are pollination dependent crops, but no habitats suitable for pollinators (Figure 5).
- soil retention, and specifically the areas where soil is not adequately retained and erosion can occur (Figure 6);

Current assessment is only available in physical terms; its monetary valuation would justify restoration and maintenance costs of restoration or remediation actions.

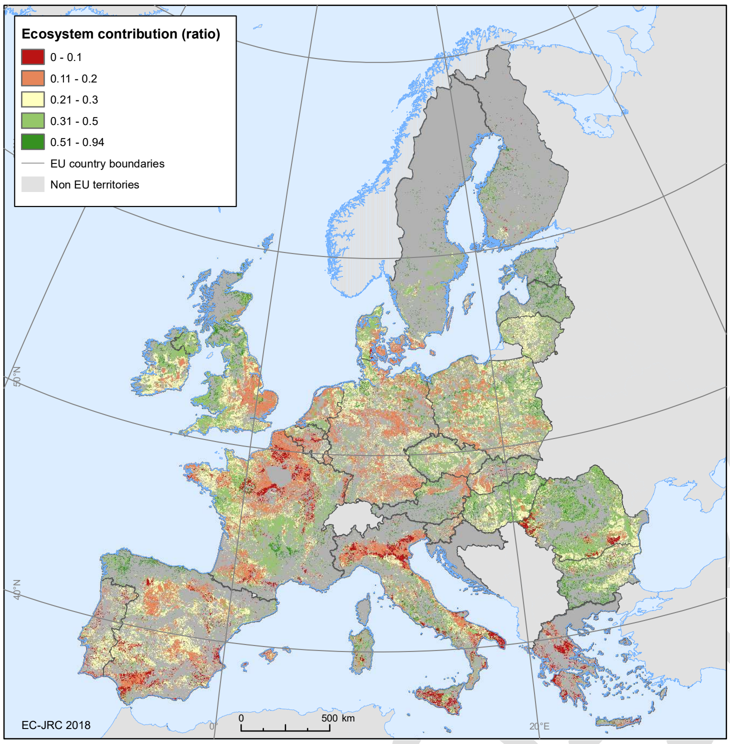


Figure 4 – Crop provision ecosystem contribution, 2012

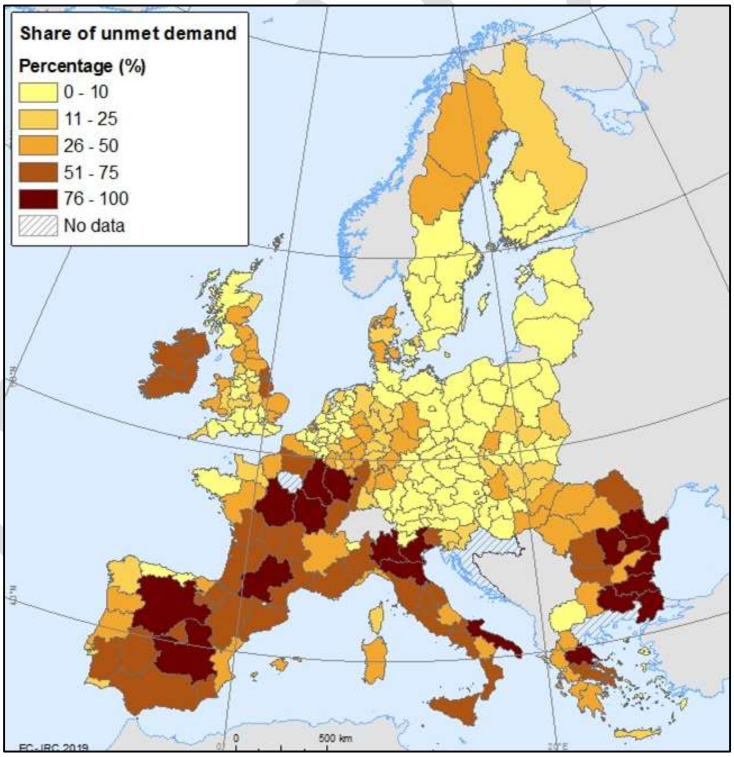


Figure 5 – Crop pollination mismatch between ES potential and ES demand, 2012

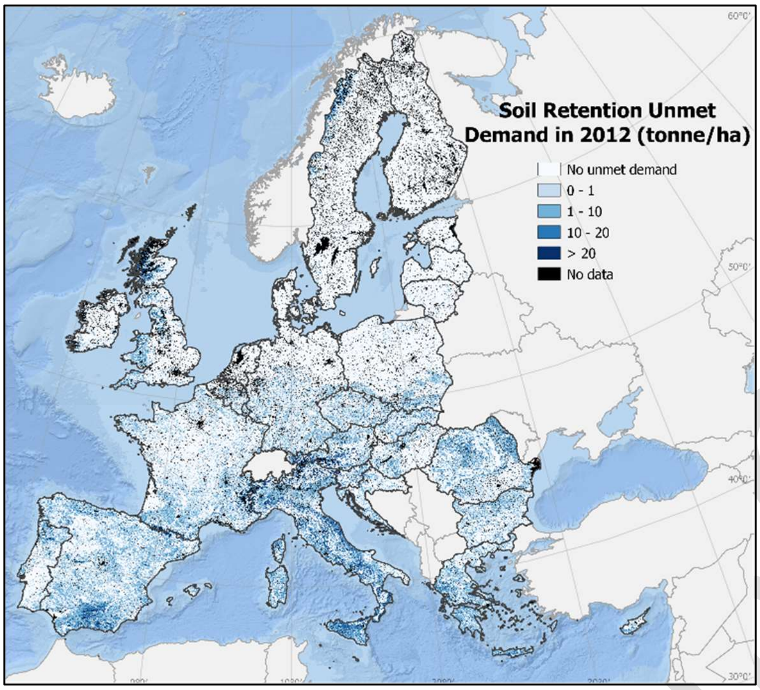


Figure 6 – Soil retention mismatch between ES potential and ES demand, 2012

3.2 Where to restore habitats to address Climate Change adaptation?

We are already facing some of the consequences of climate change. Among extreme events, flooding is becoming an emergency that we need to address each year more often than expected. The protection against the risk of flooding is a service that can be provided by human (grey) infrastructures, by ecosystems or by a combination of both. In some cases, although there is a need for protection by economic assets or human settlements, there is no ecosystem providing this service. The cost of restoring habitats where there is the need for areas providing the flood control service would area would be justified by the monetary estimate of the flood control unmet demand, based on damage costs.

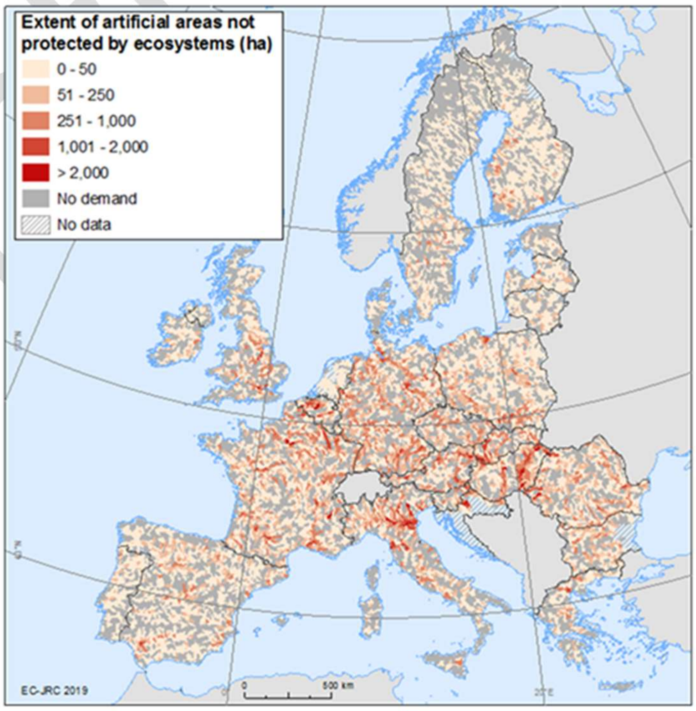


Figure 7 – Flood control mismatch between ES potential and ES demand, 2012

3.3 Where to restore habitats to reduce ecosystem degradation?

In freshwater ecosystems, eutrophication is predominantly caused by human actions due to their dependence on using nitrate and phosphate fertilizers. The assessment of nitrogen concentration above its sustainability threshold (1 mgN/l) (Figure 8) enables to calculate the replacement costs to be afforded if ecosystems get too degraded to remove nitrogen. Replacement costs justify and support investment in restoration actions.

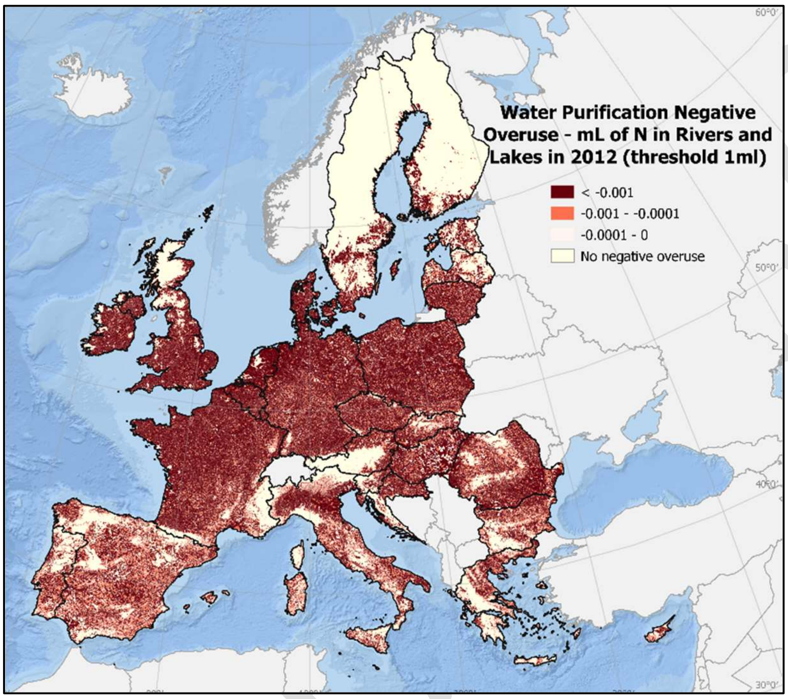


Figure 8 – Water purification overuse, 2012

3.4 Where to restore habitats to improve the quality of life?

The presence of natural areas accessible for recreational purposes can positively affect the quality of life perception by residents. Where natural areas are too far to be quickly accessed, then recreation is not anymore a daily opportunity offered to residents. The monetary estimates of the unmet recreation opportunities (Figure 9) justifies investments in restore ecosystems able to provide nature-based recreation.

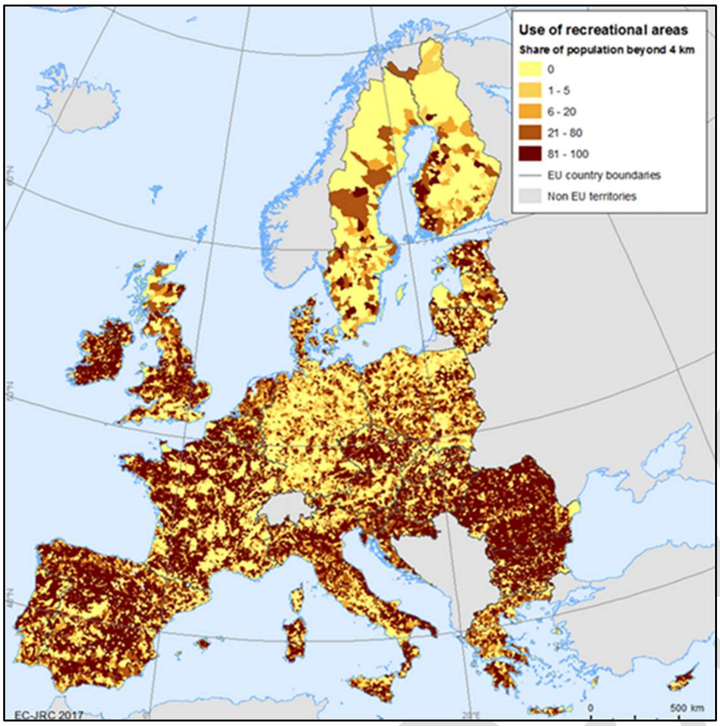


Figure 9 – Nature-based recreation mismatch between ES potential and ES demand, 2012

3.5 Where to restore habitats to contribute to overarching environmental target?

Examples of overarching environmental targets are Climate Change mitigation (whose reference ecosystem service is carbon sequestration) and Biodiversity loss (whose reference ecosystem service is habitat and species maintenance). Under current condition there is flow of service that does not reach the Global society because of bad management practices of the territory or because ecosystems are absent or degraded. Restoration actions are, for example, needed where species are at risk (Figure 10).

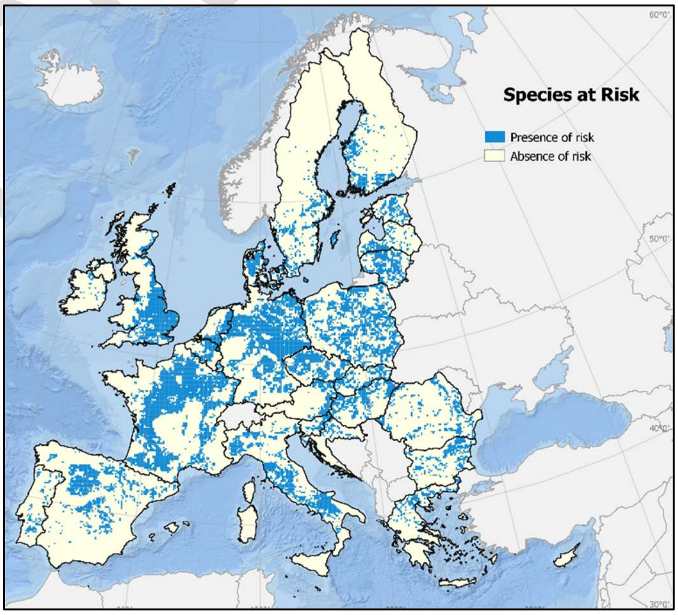


Figure 10 – Habitat and Species maintenance mismatch between ES potential flow and ES demand, 2012