# An analytical framework for mapping and assessment of ecosystem condition: Proposal to organise the work until June 2017

**Much work on condition is already prepared by MAES. We need to bring this together in a consistent draft MAES report which contains clear proposals for the member states**

- There are potentially 7 pilots/working streams which need to prepare a proposal for assessing ecosystem condition at EU and MS level: the thematic pilots forest, agro-ecosystems (cropland and grassland), urban, freshwater, marine, and the more cross-cutting pilots nature (including other MAES ecosystem types including wetlands, heathlands and shrub, and sparsely vegetated land) and soil (tbc)
- We propose that these pilots follow a common methodological framework which consists of the following steps:
  1. Define ecosystem condition descriptors per ecosystem type
  2. Select appropriate indicators following the MAES common assessment framework (pressure, state, impact on biodiversity) based on existing material, including the MAES cards compiled for the 2nd MAES Report[1]
  3. Describe the link between ecosystem condition and ecosystem services
  4. List the European datasets available to quantify the indicators at EU level
  5. Validate and discuss with member states the proposals per pilot (workshop with member states)
  6. MAES report on condition with per ecosystem type proposals for the steps 1 to 4

Contents



[1] 2nd Maes Report
http://ec.europa.eu/environment/nature/knowledge/ecosystem_assessment/pdf/2ndMAESWorkingPaper.pdf
Ecosystem condition https://circabc.europa.eu/w/browse/3c54ce29-f028-49ce-ac38-d92cfbe85a87, Agro
https://circabc.europa.eu/w/browse/a486f161-6032-4d22-98ab-d5126b04806d
Forest https://circabc.europa.eu/w/browse/2f74716f-e99f-4401-b387-4411155df378 Freshwater
https://circabc.europa.eu/w/browse/4f653b1b-159c-4d85-ae83-1f38d0876a6d and marine ecosystems
https://circabc.europa.eu/w/browse/1c4bd4c6-7ac0-453c-b602-19624243ff27 , nature
https://circabc.europa.eu/w/browse/a1e8b35c-cb38-4981-b2e8-e20452cde22d urban
https://circabc.europa.eu/w/browse/75ce4465-377f-47a6-9944-ce2cfe41aeb7 and soil
https://circabc.europa.eu/w/browse/615d5787-5ce5-4286-a8ea-b1e234cf6a78

# 1. Definition, reference and concept for each ecosystem type

Update from the MAES glossary:

- **Ecosystem condition** for the purpose of MAES, ecosystem condition is used as a synonym for **'ecosystem state'**: The physical, chemical and biological condition of an ecosystem at a particular point in time. The biological condition is usually described by species richness and abundance (biodiversity). Condition determines the capacity to provide services. In relation to accounting ecosystem condition reflects the overall quality of an ecosystem asset, in terms of its characteristics (SEEA-EEA).
- **Ecosystem status**: A classification of ecosystem state among several well-defined categories. It is usually measured against time and compared to an agreed target (distance to target) in EU environmental directives (e.g. HD, BD, WFD, MSFD).
  From HBD
  - **Favourable conservation status** implies that habitats have sufficient area and quality and species have a sufficient population size to ensure their survival into the medium to long term, along with favourable future prospects in the face of pressures and threats.

  From the WFD
  - **Ecological status** is an expression of the quality of the structure and functioning of aquatic ecosystems associated with surface waters.

  From the MSFD
  - **Good environmental status** (GES) is the environmental status of marine waters where these provide ecologically diverse and dynamic oceans and seas which are clean, healthy and productive (Art. 3).

  Other environmental directives provide additional status information e.g. nitrate directive for chemical status and revised NEC directive on impacts of air pollution upon ecosystems.

***Possible tasks to consider for the pilots***

- Review the above-mentioned definitions from the scientific literature, environmental legislation and from international organisations or initiatives (e.g. Ramsar, EC Communication on wise use of conservation of wetlands) to help define ecosystem condition with a specific focus on the ecosystem type.
- Propose a specific definition of ecosystem condition for each ecosystem type. If a general definition is difficult to propose try to describe what a good ecosystem condition is. Examples:
  - Freshwater ecosystems are in good condition if they are classified as having a good ecological status, a good ecological potential and a good chemical status as defined by the WFD.
  - Urban ecosystems are considered in “good condition” if the living conditions for humans and urban biodiversity are good.
- Describe the obstacles or problems for defining ecosystem condition
- Draw an ecosystem specific conceptual model which includes the pressures acting on ecosystems and the reference condition against which the current condition can be evaluated. The reference condition should describe what good ecosystem condition is. Establishing a

reference condition is challenging but a key activity. A practical way to address the problem of missing targets is to measure progress towards common agreed indicators for good condition (e.g. increase in green urban areas).

- Address and implement ecosystem interactions for condition, biodiversity and services into the overall concept.

## 2. Select the indicators and organise them according to the 2nd MAES report table 3

The basis for an indicator table per ecosystem type is table 3 of the second MAES report. They are organised under three headings: pressure indicators, condition/state indicators and biodiversity indicators for the impact of ecosystem condition on biodiversity.

***Tasks to consider for the pilots***

- Review table 3 of the 2nd MAES report and reorganise it so that there is one table per ecosystem type (see **example 1** for urban ecosystems in Annex).
- Condition was not the focus on the ecosystem pilots so an additional review of indicators may be necessary.
- Check of data availability for the respective indicators in terms of spatial and temporal resolution and coverage including ecosystem status indicators.
- Identification of needs for cross-ecosystem indicators at landscape level to describe biodiversity relevant condition at landscape and regional level.

## 3. Link condition to ecosystem services (integration)

Step 3 (integration) of the common assessment framework (2nd MAES report) links ecosystem condition to ecosystem services. There are several issues which need to be considered:

A. for the purpose of linked accounting tables on ecosystem condition and ecosystem services it is useful to analyse how different condition aspects are related to ecosystem services (see also the example for freshwater ecosystems by Grizzetti et al. 2016, see example 2 in the annex). If ecosystem service models (developed for the purpose of accounting) include data used for indicating condition, then these condition indicators should be reported in condition account tables. It implies that service assessments are sensitive to changes in ecosystem condition.
B. for the purpose of MAES it is necessary to demonstrate that good condition goes hand in hand with a delivery of multiple services. An example was provided by Bruna where the relation between freshwater ecosystem services and ecological status was calculated (see example 4 in the Annex). For other ecosystems where observations of ecosystem condition presently lack, it would be difficult to follow this approach.
C. the above approach however lacks validation based on field observations or independent data. So in addition, it is useful to collect evidence which accepts or rejects the presumed positive

relation between condition and services. OpenNESS has done this assessment for a set of ecosystem services (see also example 3 in the Annex).

***Tasks to consider for the pilots***

- Draw an arrow diagram to represent the links between condition aspects and ecosystem services (based on the tables of the 2nd and 4th MAES report) by specific ecosystem type (?); see example 2 in Annex.

## 4. Linking ecosystem condition descriptors to spatial data collections

One of the further tasks of the pilot could be to link the condition aspects to indicators and their underpinning data. EEA has already provided a number of excel sheets coupling condition indicators to data (at different spatial resolution). In addition, the third MAES report on ecosystem condition contains a first EU wide assessment per MAES ecosystem type with reference to the data.

***Suggested action for the EEA and topic centre with support from the pilot partners***

- EEA and ETC to start collecting all datasets storing them on the EEA Spatial Data Infrastructure for further analysis by the MAES partners (also useful to prepare the 2019 EU wide assessment).

## 5. Validation of the proposals and joint work with MS (after June 2017)

After the June workshop Member States and MAES working group members should comment on the proposals for mapping and assessing condition for the different ecosystem types.

## Table: Current status of the work on condition and action plan to be delivered on the June Condition workshop (step 1 to 4)

| **Pilot** | **Urban** | **Agri** | **Forest** | **Freshwater** | **Marine** | **Nature** | ***Soil*** |
|---|---|---|---|---|---|---|---|
| **Lead partner** | **JRC** | **JRC** | **JRC** | | | **EEA** | ***ENV (tbc)*** |
| ***Contributing partners*** | | | | | | | VLM (Vlaamse Land Maatschappij, Flemish Land Agency) |
| JRC | **Joachim Maes** | **Maria Luisa Paracchini** | **Jose Barredo** | Bruna Grizzetti | | Joachim Maes<br>Sara Vallecillo<br>Maria Luisa Paracchini | Arwyn Jones (tbc)<br>Alberto Orgiazzi<br>Joachim Maes |
| EEA | Markus Erhard | Jan Erik Petersen | Annemarie Bastrup-Birk | * | * | **Markus Erhard** | |
| ETC ULS | Dania Abdul Malak | Dania Abdul Malak (Pollination) | | | | Dania Abdul Malak (wetland) | Dania Abdul Malak |
| ETC BD | | Sophie Condé<br>Balint Czucz | Sophie Condé<br>Balint Czucz | Sophie Condé<br>Balint Czucz | Sophie Condé<br>Balint Czucz | Sophie Condé<br>Balint Czucz | |
| ETC ICM | | | | * | * | | |
| ENV | Julie Raynal | Vujadin Kovasevic, Jérémie Crespin (tbc) | Peter Loeffler (tbc) | Juan Pablo Pertierra (tbc) | Camino Liquete (tbc) | Frank Vassen (tbc) | *Josiane Masson (tbc)* |
| **STEP 1.** Definitions and reference frame | DONE<br>4th MAES report | To be done<br>Deadline 31/05/2017: JRC will prepare a proposal | On-going 28/02.<br><br>In the case of forest we will provide a review of the different available definitions and | | | On-going 03/03 update based on 3rd MAES report and ETC milestones and deliverables 2016 | *Ongoing – Final draft report will be published 1st half 2017 (tentative date)* |

| Pilot | Urban | Agri | Forest | Freshwater | Marine | Nature | *Soil* |
|---|---|---|---|---|---|---|---|
| | | | how they relate with the definitions in the MAES glossary. To propose one specific definition could be challenging. TBD<br><br>Setting a "reference condition" could be challenging and problematic. "Reference condition" relates to the definition of condition, and in most cases available definitions in the literature cannot be operationalised into a measurable reference condition. Therefore, the reference condition is an abstract aspiration hardly measurable in all its | | | | |

| Pilot | Urban | Agri | Forest | Freshwater | Marine | Nature | *Soil* |
|---|---|---|---|---|---|---|---|
| | | | dimensions with available indicators. TBD | | | | |
| **STEP 2.** Selecting indicators and organising the indicator table | DONE 4th MAES report | To be done Deadline 31/05/2017: JRC will prepare a proposal | Planned 30/04 | | | First draft 08/03 Final version before end April | A workshop dedicated to MAES soil is planned 13 May 2017 at JRC-Ispra. |
| **STEP 3** Link between condition and ecosystem services | To be completed Deadline 31/05/2017: JRC will work out a proposal | To be done Deadline 31/05/2017: JRC will prepare a proposal | Planned 31/05.<br><br>Following example 2 in the forest pilot seems a reasonable option. This could be based on literature review and expert knowledge from the Pilot participants. It would be important to have further feed-back from MS after the workshop in June for a more comprehensive list of links. | | | To be further elaborated (see pollination fact sheet) Requires service specific sensitivity analysis with respective JRC and EEA partners involved | |

| Pilot | Urban | Agri | Forest | Freshwater | Marine | Nature | *Soil* |
|---|---|---|---|---|---|---|---|
| **STEP 4** Collecting datasets per indicator | This will be part of the EnROute project (MAES follow up pilot). JRC to make a proposal for subsequent input from EEA and ULS Deadline 30/11/2017 | Plan to be decided together with the pilot steering partners Deadline 30/11/2017 | Planned 30/11/2017<br><br>Input from Pilot leader and co-leaders needed for setting a comprehensive list of datasets.<br><br>TBD in video conference | | | Key data sets available. Access to additional information under constant evaluation | |

* Contributions from EEA on Water and Marine can only be based on the European Water Assessment report (WFD second round of RBMPs) and the Marine Assessment Frameworks, which are currently under development. Contacts for ongoing work on JRC side would need to be related to these current assessments at EEA and should be developed alongside these. From 2018 onwards, EEA contributions will be possible based on the 2017 work.

**Example 1:** Indicator framework for measuring the condition of urban ecosystems

| **Pressures indicators of urban ecosystems** | | | | |
|---|---|---|---|---|
| ***Class*** | ***Indicator*** | ***Scale*** | | |
| | | R | M | U |
| Urban Sprawl | Percent of built-up area (%) | ● | ● | |
| | e.g., Weighted Urban Proliferation (Urban Permeation Units $m^{-2}$) (Jaeger and Schwick 2014) | ● | ● | |
| Air pollution | Concentration of $NO_2$, PM10, PM2.5, $O_3$ (µg $m^{-3}$) | ● | ● | ● |
| | Number of annual occurrences of maximum daily 8 hour mean of $O_3$ > 120 µg $m^{-3}$ | ● | ● | ● |
| | Number of annual occurrences of 24 hour mean of PM10 > 50 µg $m^{-3}$ | ● | ● | ● |
| | Number of annual occurrences of hourly mean of $NO_2$> 200 µg $m^{-3}$ | ● | ● | ● |

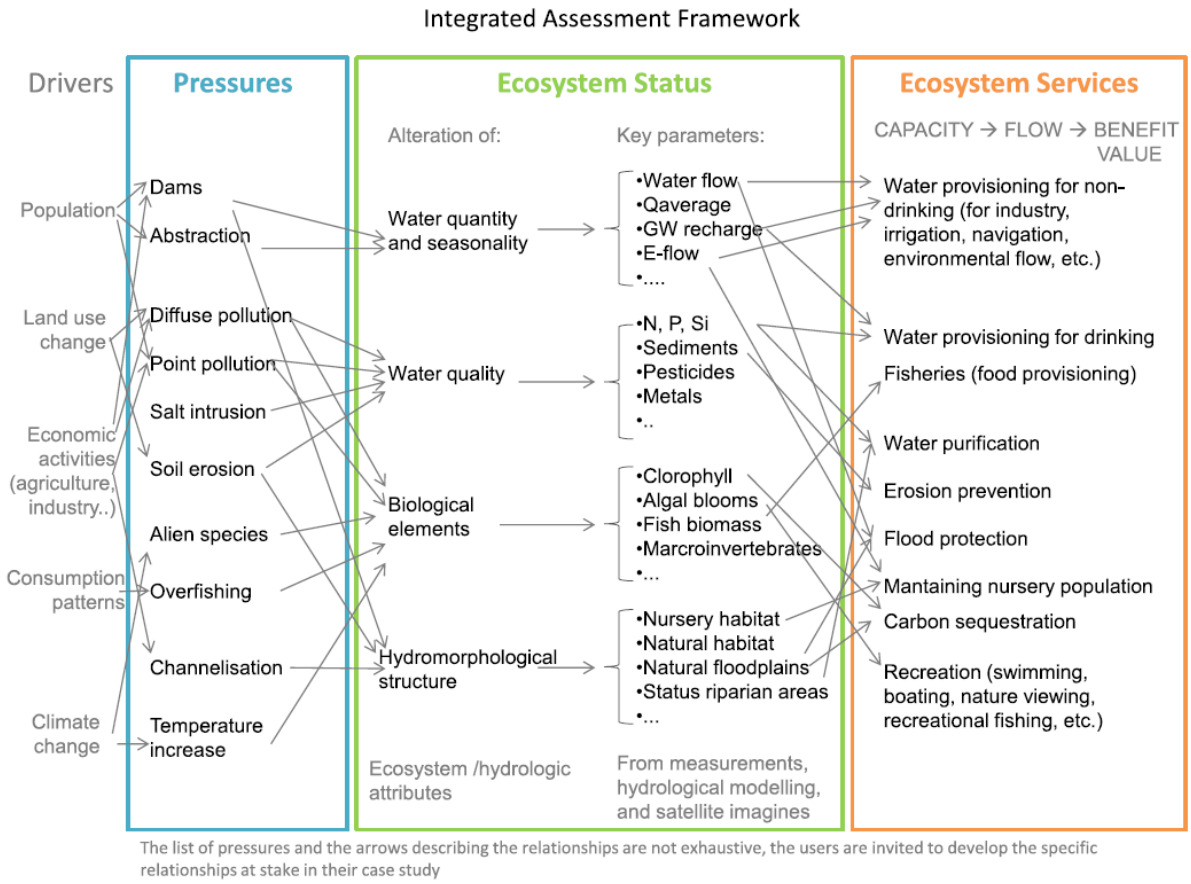
| **State indicators of urban ecosystems** | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Built infrastructure** | | | | | **Green infrastructure** | | | | |
| ***Class*** | ***Indicator*** | ***Scale*** | | | ***Class*** | ***Indicator*** | ***Scale*** | | |
| | | R | M | U | | | R | M | U |
| Population density | Number of inhabitants per area (number $ha^{-1}$) | ● | ● | ● | Urban forest pattern | Canopy coverage (ha) | | ● | ● |
| Land use and land use intensity | Artificial area per inhabitant ($m^2$ $person^{-1}$) | ● | ● | ● | | e.g., different indicators based on forest pattern and fragmentation including SEBI 13 | | ● | ● |
| | Land annually taken for built-up areas per person ($m^2$ $person^{-1}$) | ● | ● | ● | Tree health and damage | e.g. foliage damage crown dieback; measurements based on visual inspection of trees | | ● | ● |
| Road density | Length of the road network per area (km $ha^{-1}$) | | ● | ● | Connectivity of urban green infrastructure | Connectivity of GI (%) | | ● | ● |
| | | | | | | Fragmentation of GI (Mesh density per pixel) | | ● | ● |
| | | | | | | Fragmentation by artificial areas (Mesh density per pixel) | | ● | ● |

| **State indicators related to the ratio between green and built infrastructure** | | | | |
|---|---|---|---|---|
| ***Class*** | ***Indicator*** | ***Scale*** | | |
| | | R | M | U |
| Land use | Proportion of urban green space (%) | ● | ● | ● |
| | Proportion of impervious surface (%) | ● | ● | ● |
| | Proportion of natural area (%) | ● | ● | ● |
| | Proportion of protected area (%) | ● | ● | ● |
| | Proportion of agricultural area (%) | ● | ● | ● |
| | Proportion of abandoned area (%) | ● | ● | ● |

| **Indicators of urban biodiversity** | | | | |
|---|---|---|---|---|
| ***Class*** | ***Indicator*** | ***Scale*** | | |
| | | R | M | U |
| Species diversity | Number and abundance (number $ha^{-1}$) of bird species | ● | ● | ● |
| | e.g., number of lichen species | ● | ● | ● |
| Conservation | Number and abundance (number $ha^{-1}$) of species of conservation interest | ● | ● | ● |
| Introductions | Number of alien species | ● | ● | ● |

R: Regional scale; M: Metropolitan scale; U: Urban scale

**Example 2: Linking condition and service indicators.** Note this example shows a non-exhaustive list of links. So for other ecosystems the work could cover the most relevant relationships but it is acceptable that this will not deliver an exhaustive review.



**Example 3: Supporting evidence on the link between biodiversity/condition and ecosystem services based on OPenNESS deliverable D3.1**

Number of scientific articles reporting positive correlations between ecosystem properties and ecosystem services (based on a sample of 50 studies per ecosystem service)

Number of scientific articles reporting negative correlations between ecosystem properties and ecosystem services (based on a sample of 50 studies per ecosystem service)


**Example 4. Supporting evidence on the link between ecological status and freshwater services**

| | Ecosystem Service Indicators | | | |
|---|---|---|---|---|
| | Capacity | Flow | Efficiency or Sustainability | Benefit |
| *Provisioning* | | | | |
| Water provisioning | (↗) ↘ | (↘) ↘ | (↗)↘ | |
| *Regulating* | | | | |
| Water purification | (↗) ↗ | (↗) ↘ | (↗) ↗ | |
| Sediment mitigation | (↗) ↗ | (↗) * | (↗) * | |
| Flood protection | (↗) ↗ | (↗) ↗ | (↗) ↗ | |
| Coastal protection | (↗) ↗ | (↗) ↗ | | (↘) ↘ |
| *Cultural* | | | | |
| Recreation | (↗) ↗ | (↗) ↗ | | (↘) |

Correlations between Ecological status and ecosystem service indicators (From Grizzetti presented at the MAES condition meeting in Ispra)