

Webinar: 'Mapping habitats by combining satellite and other data'

Co-organisers: DK Environmental Protection Agency, EEA and Biodiversa+

**Within the Eionet Group for Biodiversity and Ecosystems
Integration of knowledge for policies framework.**

Document providing the 1) final agenda of the webinar, 2) key final reflections by the organisers and mentimeter results on next steps, and 3) summaries of the two break-out sessions.

1) Final agenda

20 January 2023, 10.00 to 15.00pm CET on Microsoft Teams

A) EU section (chair: Jan-Erik Petersen, EEA)

- 10.00 – Welcome and purpose of the meeting, by the EEA, Danish
10.10 Environmental Protection Agency and Biodiversa+
- 10.10 – Policy needs for habitat mapping data at EU level (overview and
10.30 review of key data challenges), by Jan-Erik Petersen, EEA
- 10.30 – Presentations on current EU level habitat mapping work,
11.00 combining satellite with vegetation plot and other data, by
Stephan Hennekens (WENR, The Netherlands)
- 11.00 – Two parallel breakout session to:
11.45 - discussion on policy needs
- review of methods and progress at EU level
- 11.45 – Feedback to plenary and next steps
12.00

12.00 – 13.00 Lunch Break

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**Ministry of Environment
of Denmark**

Environmental
Protection Agency

B) Country section (chair: Petteri Vihervaara, SYKE Finland)

13.00 – Presentation on first results of country survey on habitat mapping
13.15 approaches, by Jan-Erik Petersen, EEA

13.15 – Presentations of ongoing projects and experiences from EEA and
14.40 Biodiversa+ member countries, focus on technology used,
resolution, habitat types – potential and limitations discovered

Four country presentations followed by a Q&A session (facilitated by Ditte Galsgård; Danish Environmental Protection Agency):

- Rasmus Fenger-Nielsen, Danish Environmental Protection Agency
- Alexia Aussel, PatriNat (National Museum of Natural History – French Biodiversity Agency - French National Centre for Scientific Research - French National Research Institute for Sustainable Development), Paris, France
- Cristina Moreno Gutiérrez, Ministry for the Ecological Transition and the Demographic Challenge, Spain
- Ján Černecký, State Nature Conservancy of Slovak Republic

14.40 – Reflections by organisers and next steps to take:
15.00

- Outcome of webinar and next steps at EU level (EEA)
- Ideas for sharing knowledge across borders (DK)
- Likely future research streams (Biodiversa+)
- Ideas for further workshops (Biodiversa+ / all)

15.00 – End of the webinar

2) Notes on final reflections by organisers and next steps to take:

The three organisers (EEA, DK EPA and Biodiversa+) briefly reflected on the outcome of webinar and what could be next steps to follow up. All considered the presentations and discussions to have been very interesting and productive, and to merit substantial follow-up to build on what has been achieved. This includes a 2nd round of the country survey and a detailed analysis of responses.

The EEA announced that all presentations and summary notes for the webinar plus Teams recordings will be made available via the Eionet Forum page for the webinar. In addition, the EEA will take the insights gained at the webinar into EU level planning discussions on what could be next steps for further developing work on habitat mapping at EU level. The EEA would also like to continue the EU – country level interactions to learn from each other, hopefully build a community of practice, and to explore whether a common pool of in situ reference data can be built to enable a more successful and accurate interpretation of satellite data for habitat mapping.

Ditte Galsgard of the Danish EPA focused on the aspect of peer-to-peer learning between countries and presented some ideas for further sharing knowledge across borders (see also mentimeter result below).

Petteri Vihervaara of Biodiversa+ gave a brief over of Biodiversa+ activities and structure and reflected on how the development of habitat mapping (satellite-based and beyond) could be integrated into likely future research streams and pilot actions of Biodiversa+.

During the final session the organisers set up a mentimeter survey on what would be the priority follow-up actions in view of the participants. Each person entering their preference had one vote to choose between 5 different options. 61 votes were submitted in the quick survey with the following result:

22 Votes: A web-based knowledge hub on habitat mapping

17 Votes: More webinars on technical topics (eg models/AI methods, estimating uncertainty etc)

15 Votes: More webinars to share country experiences on habitat mapping in general

7 Votes: Physical workshop in Copenhagen

0 Votes: Other

The organisers will get together during February to review options for further follow-up to the webinar in light of the mentimeter results. Any countries or EU bodies wishing to offer support for a webinar, workshop or other follow-up would be very welcome !

3a) Annex 1: draft summary of break-out session 1

Authors of summary: Janica Borg (EEA), Cecile Mandon (Biodiversa+)

Objectives of the break-out discussion:

1) Identify key policies

The group had a quick discussion on this point & identified some key policies:

- EU Biodiversity policies (ie Birds and Habitats directives)
- Nature restoration law (future reporting)
- Funding policies (eg. LIFE, CAP...)
- Water Framework Directive (more comprehensive than marine, information needed is broad, environments are well-mapped. It may lack some homogeneity between countries and habitats, yet lots of information available.)
- Marine Strategy Framework Directive
- Biodiversity Strategy – this does not have any specific reporting requirements but policy targets to be monitored (relevance of habitat data to be explored)

Challenges faced at national scale:

- In Denmark, they might have different types of data coming out due to use of digital techniques and this may have an impact on the reporting. They don't know yet exactly what type of data they will get from new digital mapping techniques, but it will probably differ from the field-based way of collecting data in some ways. Data could show different things like a more specific habitat mapping in a smaller scale than now but with less botanical observations. Data might give the same result but based on another type of data. It may be hard to keep some trends, since data could have different formats.
- Question: what should we be collecting so that data are useful for several purposes. How to ensure that collected information is sufficiently complete/ detailed for several purposes. May want to go beyond an EU habitat mapping approach that may not have the detail to be useful for local decisions.
- Important to show the quality of habitats and not just map the distribution of habitats. Quality will help to know where to restore. We also need several maps, over time, to see where habitat improves or not. This will help policy makers. >> this is another challenge as it may not be feasible for all countries to produce regular mappings and as such we need to reach a balance.
- Another challenge lies in integrating different sectoral approaches: a challenge is the definition of habitat types between different user communities (e.g. forest sector v nature conservation purposes). Some sectors can get better data than others for some areas. If data is relevant for another sector, the data categories may however not be a good fit for that other sector.
- In Norway there is an ongoing discussion to develop an ecosystem accounting system. They are willing to learn and harmonise this process with other countries. In Norway they have their habitat classification. Norway tries to find a system compatible with ecosystem accounting

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work and the Eurostat SEEA module. But this requires a lot of communication and coordination efforts.

Discuss ecological detail needed

In Sweden, they are using new technologies to map their habitats such as air-born lidar. This helps to complete the mapping of habitats but is not enough on its own. Nevertheless, it helps to improve the quality of the current data.

Sweden uses a 10x10 m resolution, for thematic resolution they are trying to get more classes.

If you have terrain information, you get the right information to identify likely habitat locations and can then collect more data so that you can cover more area. But this is work intensive. Has this approach been used somewhere else? This has been developed for identifying coral locations and been used to map coastal areas of Sweden and fill the gaps. Methodology depends on ecological causalities and may not be practical for all types of habitats and look at all the layers.

Comment from Teams chat: In Finland, they are struggling with similar issues to those just described for Norway. On top of that, multiple habitat classification systems are used nationally also (different systems for different purposes). Currently there are some initiatives to find a national consensus "backbone" classification system to which all other systems can be traced back to. Unfortunately, several national actors do not find the EUNIS systems very suitable to describe Finnish habitats.

Teams comment from Pekka Hurskainen:

One important aspect is the exclusiveness of the habitat delineations. Can habitat boundaries overlap, i.e. can one hectare of land belong to one or several habitat types? Some data might be collected in this way, while some policy needs, for example ecosystem accounting, require exclusiveness: each hectare can only belong to only one type. This relates to the problem of how complex nature is and how much we simplification is required through modelling.

2) Review spatial detail needed

What is meant here? What level of information do we need? 10 square meter data? Higher resolution you have is good so that you can then scale it up. Pragmatically, however this depends on what is feasible at national scale in each country. Being stuck in one particular resolution can be a problem when collecting some data for other habitats, especially rare habitats. Different resolution levels can also help see several types of trends. Spatial data is very important but also depends on what we are looking for (type of habitats we intend to describe and how common they are).

In Italy, they are also reviewing their habitat mapping classification. They aim to define the requirements for the different scopes and features they want to describe. Based on these requirements they will agree on the resolutions that are needed.

Teams comment from Florian Wolf-Ott: we would appreciate 10 x 10 m resolution for our field monitoring of small areas covered temporarily by water (after floods, groundwater infiltration or

meteor waters) for detecting a rare fish species in Austria (M. Fossilis) which sentinel data up to now would boost our monitoring capabilities. Difficult to have this resolution as remote sensing cannot help, as such they have to do ground work which is costly. Remote sensing can however help prevent flooding. New monitoring will probably use eDNA methods in addition to traditional methods.

SUMMARY of key points :

- Digital transformation is coming and we need to be prepared for it.
- Use of Lidar can improve results compared to other methods
- Collecting data on a higher resolution and then scaling up to a habitat map → gives information that can be used also on local level (habitat maps). More work, but you get multiple uses of the same data. Scaling up has to work.
- Nature Restoration Law: info is needed 1) where the habitat is, and 2) on it's condition (good/bad), and 3) regular updates are needed
- Common habitat definition is needed, coordination efforts are needed.
- Spatial resolution: being stuck in one resolution risks missing rare habitats. What's possible for EU countries ?
- Resolution: X-mas wish from Norway; 10x10 meters. NO remote sensing agency says it's not possible for forests.
- In-situ data will be pushed (or published ?) forward

3b) Annex 2: draft summary of break-out session 2

Summary of break-out session 2. Review of methods and progress at EU Level.

Authors of summary: Bruno Smets (VITO), Marc Paganini (ESA)

1. Which habitats were covered?

Mostly Annex I of Habitats Directive (HD) and/or EUNIS typology were used by countries, however EUNIS is not much used in Scandinavia because some dominant species & ecological functions were not defined properly in older (2012) EUNIS classification. The new revisions (2019 and later) are looking promising and may be considered for adoption by Scandinavian countries.

As stated above, the Scandinavian countries collect vegetation plots according to their own schemes. Other countries use surveys linked to EUNIS classification, the habitats listed in Annex I of HD or relevant national vegetation type classifications. This may include a combination with European Vegetation Plot data (e.g. EVA database) but the extent of such an approach is not known. The data collected is used primarily for national reporting and is stored in national data bases.

Vegetation plot data collections are not homogenous across EU countries in terms of density and representativity of EVA plots at (sub-)national level. Furthermore, Scandinavian plot observations are often not complete recordings of species. Only dominant species are recorded and therefore difficult to use for EUNIS habitat identification.

It would be important to establish a harmonized and accepted protocol to gather new plots, taking into account EUNIS types. In the context of using vegetation plots as training data for habitat mapping with satellite data an appropriate sample scheme needs to be established. This should take account of the need for geometric accuracy, spatial uncertainty, aligned timespan – stable or changing habitats & coincide with satellite observations, and a good distribution of habitat types (e.g. area-weighted).

Crosswalks between different classifications are important, also with specific national habitats. The advantage of EUNIS as a base classification scheme is the wall-to-wall coverage.

Some habitats / habitat levels (from EUNIS level 3 or 4 onwards) will be hard to map using satellite, so it is assumed that a mixed-level habitat map will remain a standard. This map will identify areas of interest to conduct field surveys to (i) either validate/confirm the habitat or (ii) detail the habitat to a higher level.

2. Which methods were tested & what was the accuracy of results?

Up to now, most methods use field surveys, however several projects & countries are exploring the use of satellite data with (or without) Machine Learning to map habitats. The results are promising, however further research is needed to mainstream this method. Some initial results indicate that satellite derived habitat maps allow identifying erroneously mapped areas in survey-derived maps - where satellite approaches allow good thematic habitat identification.

The 3 main problems with EVA database are (1) location uncertainty, especially when working at 10m spatial resolution, (2) time span (remove all EVA training data before 2000), and (3) not enough vegetation plots for certain habitats (not an equally balanced set of plot samplings)

In the cases discussed, Random Forest was found to provide more accurate results than Maxent suitability mapping. It is also considered important to continue to invest in the development of satellite-derived maps using ML/AI techniques. It is also expected that at some point these maps will provide better geometric accuracy (at least for most, not all habitat classes). [Ground truth data for training satellite data / machine-learning methods remain a critical component for good thematic and spatial identification though.]

Methods should be able to cope with different scales which depend on type of habitat (micro-scale versus large-scale habitats).

The Area of change of habitats (a Habitats Directive reporting parameter) is found as the first indicator / test of integrating ML/AI with satellite data. It is important that sufficient investment is made in the generation of a base map, from which an independent model can be applied to detect hotspots of (potential) changes. These (potential) changes can then be assessed first with ML/AI – satellite mapping, but will also require field surveys to confirm & (sometimes) map the new habitat classes.

Ecosystem structure and function, as indicators of the Habitats Directive, are currently done using plots data. Some countries have doubts that ML/AI-satellite could contribute a lot here. More feasibility analysis would be helpful.

Stratification at regional level is important, as it helps to optimize both the predictors and the ML/AI model training. So, plot surveys should not only deal with good distribution at EU scale, but also at regional scale.

3. What combination of input data was/should be used?

Next to field plots data (see point 1.) and the standard satellite signals (Sentinel 1 & 2), it was noted that also LIDAR is an important source and should be considered.

4. Any other points to consider?

In response to the reporting back the EEA suggested that it would be interesting to explore the possibility of using original vegetation plot (or similar survey) data that were collected at country level in support of reporting under the Habitats Directive as test data for the result of satellite-based habitat mapping.

However, a lot of the national databases used for habitat mapping have also been submitted to the EVA and it needs to be investigated to what extent and how such national databases have been used for HD reporting.