Programme co-funded by the European Union

Interreg
Danube Transnational Programme
DaRe to Connect

ONLINE MANUAL

FOR THE USER-FRIENDLY GIS TOOL

Deliverable D 4.4.2

Report
11 2021

WP4 Pilot Actions

Activity 4.4 User friendly GIS tool for using remote sensing data

universität wien

Deliverable description

Online manual: Elaboration of an online manual how to use the developed GIS application-tool, the manual and the application tool will be available on PPs websites and by other relevant online media.

Introduction

Based on the developed methods that take advantage of using High Resolution Layers and Sentinel-2 satellite data to classify the Broader Habitat Types and their connectivity as well as for identifying ecosystem service provisions and by GIS data processed during the implementation of the D2C project, a user-friendly GIS tool was developed. It offers local and regional stakeholders that are dealing with ecological network preservation and restoration in the DTP Programme area - especially within the Pilot Regions but also beyond - a tool to identify natural features and potential ecological corridors on local and regional level.

Particularly staff members of authorities responsible for nature conservation and Natura 2000 sites can profit from the GIS tool by identifying the condition status of Natura 2000 habitats by remote sensing data instead of conducting or commissioning expensive field work. The geodata provided by the GIS-tool can also serve as a basis to select areas and plan for a more detailed and targeted assessment of habitats in the field.

The small and user-friendly free GIS tool is accompanied by this online manual in order to explain the contents and results shown as well as guide the user through the functions of this web tool and benefit from the provided results.

A strong emphasis is put here on chapter Citation for referencing the content correctly!

Contents

1. The Content

What can be retrieved with the GIS tool?

The main objectives of the responsible respective work package of the D2C Project were

- the enhancement of connectivity of Natura 2000-areas along the Green Belt in the Danube Region (corridor of 50 km)
- the identification of suitable ecological corridors between and areas for the improvement of connectivity of protected areas and
- the analysis of suitable transnational ecological corridors.

In the course of completing these tasks, several analyses using remote sensing data were conducted. The results of those analyses can be accessed in this tool. In order to understand the meaning of those geodata, the following chapters will give a short overview of the covered content and explanations for each data set.

1.1 Data basis – Pilot Regions vs. the European Green Belt (EGB)

The D2C project focused the analysis of the ecological corridors on two levels.

1. within the Pilot Regions:

Since the approach for the Pilot Regions used Sentinel-2 satellite imagery (ESA, 2019), where large amounts of data had to be handled and processed, only 4 of the 6 Pilot Regions were assessed using this method. The 4 considered Pilot Regions were

- PR1 – Bavarian Forest-Mühlviertel-Šumava(DE-AT-CZ, 100x100km)
- PR3 – Őrség-Goričko (HU-SL, 100x100km)
- PR4 – Iron Gates-Djerdap (RO-RS, 100x110km)
- PR5 – Dráva River in Virovitica County (HR, 41x100km).

For these regions the Sentinel-2 data provided an up-to-date high-resolution raster image with a pixel size of 10x10m. By using training data such as ground truthing by the project partners and other biotope mappings, each pixel of the PR was classified and assigned to one of the Broader Habitat Types (BHT) using a machine learning algorithm of the satellite data time series of 2017 & 2018.

2. for the entirety of the EGB in the Danube Region:

As already mentioned above, the processing of those huge amounts of data limited the application of this data source on 4 Pilot Regions. In order to fill the data gaps for the whole EGB, geodata of the EUNIS habitat classification (EEA, 2012) was used here. With a coarser resolution of 100x100m pixel size, this data is, of course, not as informative on the very local scale, but offers more than enough detail to gain valuable insights on the ecological network on a regional and transnational scale. This data set was translated to the BHTs as well.

1.2 The Results

In the paragraphs below each of the included results are shortly outlined.

1.2.1 Broader Habitat Types (BHT)

This is a classification system for natural and anthropogenic land cover types (according to BUNCE et al. 2008, 2011) such as for example bogs, rivers and streams, different kind of grasslands and woodlands etc. (Figure 1). It was elaborated for the 4 Pilot Regions based on the Sentinel-2 classification and the whole EGB based on the data of the EUNIS habitat classification.
This data sets are the essential basis for the further analyses, assessments and monitoring.

Figure 1 Legend of the Broader Habitat Types in Pilot Region 1.

1.2.2 Ecosystem Services (ESS)

The ESS are defined as all goods and services that landscapes provide for sustaining life as well as benefits for human well-being. They include potentials, materials and processes of the nature (e.g. raw materials, biomass, biodiversity etc.) and also services of man-made cultural elements and constructions (e.g. agriculture, buildings, infrastructure, etc.).

By the definition of the Millennium Ecosystem Assessment (MEA) “ecosystem services” comprise various benefits for human beings provided by ecosystems. Thus, these ecosystem services not only sustain fundamental human needs but also have a high economic value. (MEA, 2005; TEEB, 2010)

So, in order to create a sound matrix of ecosystem service capacities for the land cover types along the Green Belt in the Danube Region, an existing matrix for the whole of Europe by Stoll et al. (2015) was used as template. It then was assigned to the definitions of Landscape services by de Groot et al. (2002, 2006 and 2010) and revised by the experts of each project partner.

The capacity matrix assigns values to each of the BHT using the respective CORINE land cover type as reference. These values are ranging from:

- 0 = no capacity
- 1 = very low capacity
- 2 = low capacity
- 3 = medium capacity
- 4 = high capacity
- 5 = very high capacity

In order to the describe their potential to provide each of the 39 single ESS, which are cumulated into 5 Main Services (based on de Groot 1992 and de Groot et al. 2002) and the combined value of all the ESS provided – the Total Function Value:

- **Regulation functions**: This group of functions relates to the capacity of natural and semi-natural ecosystems to regulate essential ecological processes and life support systems through biogeochemical cycles and other biospheric processes. Regulation functions maintain a "healthy" ecosystem on different scales and, at the biosphere level, provide and maintain the conditions for life on earth. In many ways, these regulation functions provide the necessary pre-conditions for all other functions. In theory, the number of regulation functions would be almost unlimited, but for landscape planning, only those regulation functions are considered that provide services, which have direct and indirect benefits to humans (such as maintenance of clean air, water and soil, prevention of soil erosion and biological control services)." (de Groot 2006, p. 177)
- **Habitat functions**: Natural ecosystems provide refuge and reproduction-habitat for wild plants and animals and thereby contribute to the (in situ) conservation of biological and genetic diversity and evolutionary processes. As the term implies, habitat functions relate to the spatial conditions needed to maintain biotic (and genetic) diversity and evolutionary processes. The availability, or condition, of this function is based on the physical aspects of the ecological niche within the biosphere. These requirements differ for different species groups, but can be described in terms of the carrying capacity and spatial needs (minimum critical ecosystem size) of the natural ecosystems which provide them." (De Groot 2006, pp. 177-178)
- **Production functions**: Photosynthesis and nutrient uptake by autotrophs converts energy, carbon dioxide, water and nutrients into a wide variety of carbohydrate structures, which are then used by secondary producers to create an even larger variety of living biomass. This biomass provides many resources for human use, ranging from food and raw materials (fiber, timber, etc.) to energy resources and genetic material." (De Groot 2006, p. 178)
- **Information functions**: Because most of human evolution took place within the context of undomesticated habitat, natural ecosystems provide an essential 'reference function' and contribute to the maintenance of human health by providing opportunities for reflection, spiritual enrichment, cognitive development, re-creation and aesthetic experience." (De Groot 2006, p. 178)
- **Carrier functions**: Most human activities (e.g. cultivation, habitation, transportation) require space and a suitable substrate (soil) or medium (water, air) to support the associated infrastructure. The use of carrier functions usually involves permanent conversion of the original ecosystem. Thus, the capacity of natural systems to provide carrier functions on a sustainable basis is usually limited (exceptions are certain types of shifting cultivation and transportation on waterways, which, on a small scale, are possible without permanent damage to the ecosystem)." (De Groot 2006, p. 178)
- **Total Function Value**: As an indicator for all the ESS included in the analysis, the Total Function Value shows the multifunctional value of the landscape regarding not only the human benefits, but also its contribution to ecological cycles and biodiversity.

1.2.3 Morphological Spatial Pattern Analysis (MSPA)

For the assessment of the connectivity of the EGB two analyses were conducted. Both were done using the GuidosToolbox (Graphical User Interface for the Description of image Objects and their Shapes; Vogt & Riitters, 2017) - a free software collection by Peter Vogt (Joint Research Centre, European Commission) and offers a variety of modules targeted to investigate several spatial aspects of raster image objects, for example pattern, connectivity, cost, fragmentation, etc. These image analysis concepts of mathematical morphology are widely used (Soille, 2013) and form the foundation of GuidosToolbox.

The Morphological Spatial Pattern Analysis or MSPA was one of those two methods. It is a generic and universal pattern analysis framework provided by a custom sequence of morphological operators (Soille & Vogt, 2008).

MSPA performs a segmentation on a binary image to identify and localize mutually exclusive morphometric feature classes describing the shape, connectivity and spatial arrangement of image objects by mapping and classifying them into categories (Vogt et al., 2017). The MSPA module automatically detects geometry and connectivity of the image components. Therefore, the foreground area of a raster based binary image is partitioned into seven MSPA classes: Core, Islet, Perforation, Edge, Loop, Bridge and Branch (Figure 2).

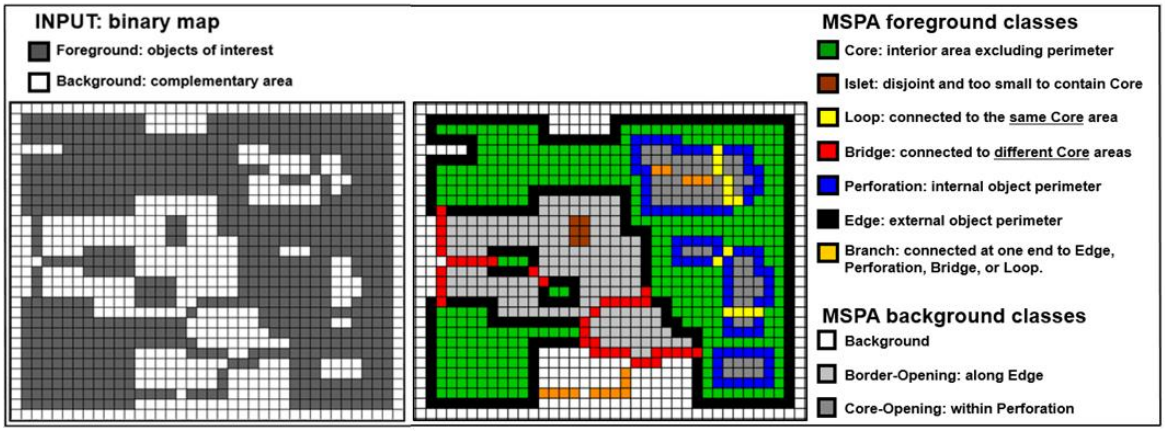

Figure 2 Definition of the MSPA classes. (EC, 2021, retrieved from: https://forest.jrc.ec.europa.eu/en/activities/lpa/mspa/, 30.11.2021)

In terms of the assessment of the connectivity of BHT of interest, MSPA uses a series of image processing routines to identify hubs, links (corridors), and other features after reclassifying the raster land-cover map into foreground (forests or grassland) and background (all other classes) (Vogt et al., 2007).

The category of core is equivalent to hub, and bridge is synonymous to link (corridor). First the MSPA processing identifies the category core, which is based on the connectivity rule used to define neighbors and the value used to define edge width (Soille and Vogt, 2008).

In the basic settings of MSPA connectivity can be set to either four (cardinal directions only) or eight neighbors. The minimum size of core and the number of pixels classified as core is affected by the settings of the edge width. By increasing the edge width, the minimum size of core increases

and thereby reduces the number of pixels defined as core areas. The decrease of core areas that results from increasing edge width arise in gains for all other classes, not just edge. This way increasing the edge width can shift core to islet if the area of core is small and core to bridge if the area of core is narrow. (Wickham et. al. 2010)

In the application of MSPA in DaRe to Connect we used eight-neighbor connectivity and an edge width value of two (2) corresponding an effective pixel size of 10 meters for this analysis. The input data is the raster (grid) map of the Sentinel-2 BHT classification of WP3 Activity 3.1 of the Pilot Region. The input map must contain the two data classes Foreground (BHT of interest) and Background (other BHT).

1.2.4 Euclidean Distance

The second module of GuidosToolbox – the Euclidean Distance – uses the same input data as the MSPA described above. It measures the degree of intactness, shape and spatial arrangement of patches on a given binary map, the analysis methodology of Euclidean Distance offers a practical and effective method of implementation.

This application creates maps of objects of interest showing the Euclidean Distance map inside (green to yellow) and outside (blue to pink) those objects. To illustrate the influence zones of each object and to derive the pairwise proximity between neighboring image objects this type of analysis may be further pursued. For the establishment of cost-efficient reconnecting pathways in restoration planning proximity may be used to locate close encounters of existing objects. (Vogt et al., 2017)

In terms of the connectivity of BHT of interest the generated distance maps provide spatially explicit information allowing for highlighting hotspots of highly fragmented areas or those dominated by well-established networks of forests or grassland. The spatial information of these distance maps may be of high importance for monitoring, planning and risk assessment. Additionally, the simple, yet intuitive analysis scheme is easy to communicate and can be related to a variety of spatial planning measures by illustrating the degree of fragmentation or intactness and allowing direct comparisons with results among the Pilot Regions.

1.2.5 Connectivity-Functionality Index (CFI)

By the combination of the two indices derived from the functionality (=ESS) and connectivity (=MSPA) analyses for the European Green Belt the Connectivity-Functionality Index (CFI) was elaborated. Therefore, the Total Function Value as well as the MSPA-classes were scaled and the mean was calculated in order to serve as an indicator for areas with high potential as multifunctional corridor between protected areas. These highlighted areas (green) are those landscape elements that provide not only a high functional value for nature and the humanity but also constitute habitats and structures of connecting importance between protected areas. Thus, the potential of elements as a multifunctional corridor can be estimated.

The resulting maps build a basis for political recommendations and prioritization and further help to define, *where which* actions are needed to support the ecological network of European Green Infrastructure (GI) the Green Belt.

1.2.6 Areas of Action (AoA)

The Areas of Action were designated using the maps of the CFI. To pursuit the aim of the D2C project to strengthen the ecological network between the protected areas, two AoA were defined depending on the existing GI in those areas of transnational importance:

1. **Safeguard**: These areas are located outside of existing large-scale protected areas, were the analyses indicate a high potential as a multifunctional corridor.
   Future nature conservation measures should mainly focus on preserving the existing conditions to improve the ecological EGB network by the prevention of converting valuable habitats to non-sustainable forms of land-use. The potential within the area as multifunctional corridor can be enhanced and amplified wherever possible.
2. Restore: These areas are located outside of existing large-scale protected areas and having a low potential as a multifunctional corridor.
   The future implementation of nature conservation measures should focus on the reinstallation of functional elements for the ecological network as well as the restauration of functionality of the existing habitats. Of course, existing valuable landscape elements also need to be considered and protected.

1.3 The User Interface

In Figure 3 on the next page, the default view after starting the GIS tool is shown. To gain an overview of the icons, they are also named for a better navigation through the web app

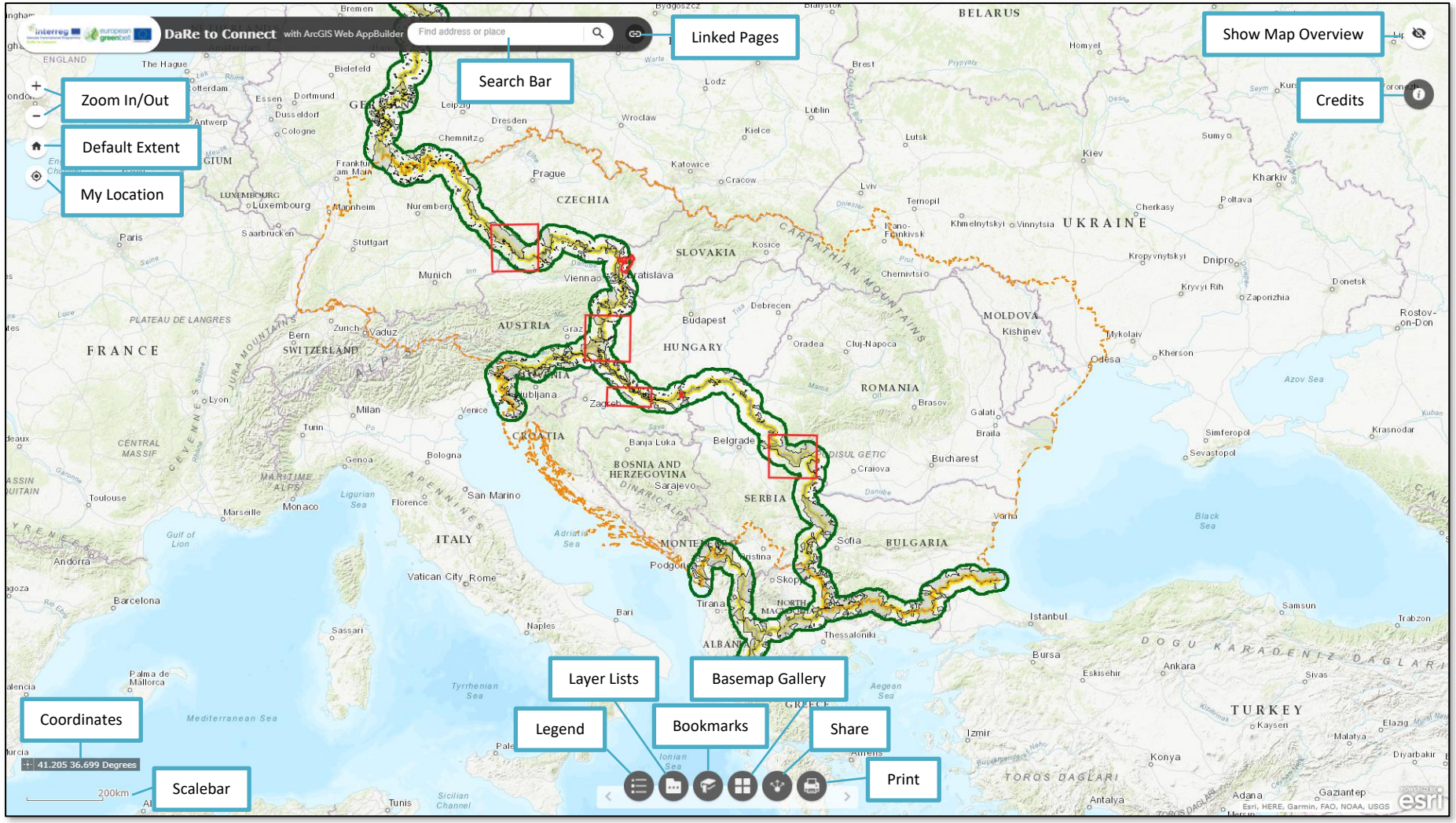

Figure 3 The default view of the Web Application with the user interface and its description.

2. Tools & functions

After clarifying the user interface of the GIS tool, the next chapters will focus on the several tools and functions that are offered. Some of them are of course quite obvious, for others more explanations need to be given.

2.1 Legend

The legend can be accessed via the button of the same name. This opens a window that shows every active layer in the web app and the associated symbol and features (Figure 4).

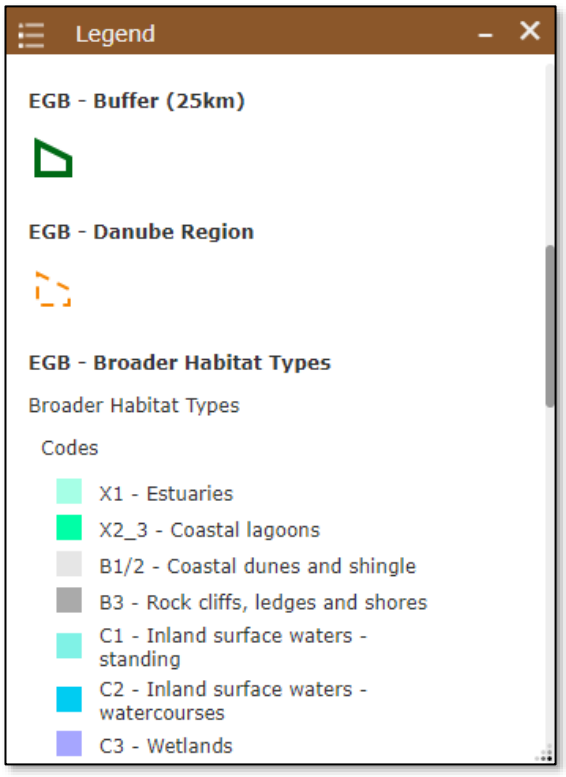

Figure 4 Exemplary legend of the EGB within the web app.

2.2 Layer Lists

The Layer Lists are organized in five subfolders: one for the layers of the entire EGB and four for each of the Pilot Regions, for which the Sentinel-2 data was analyzed – namely PR 1, 3, 4 and 5.

If you open the list for e.g. PR1 (Figure 5), each desired layer(s) can be activated by checking the respective box on the left.

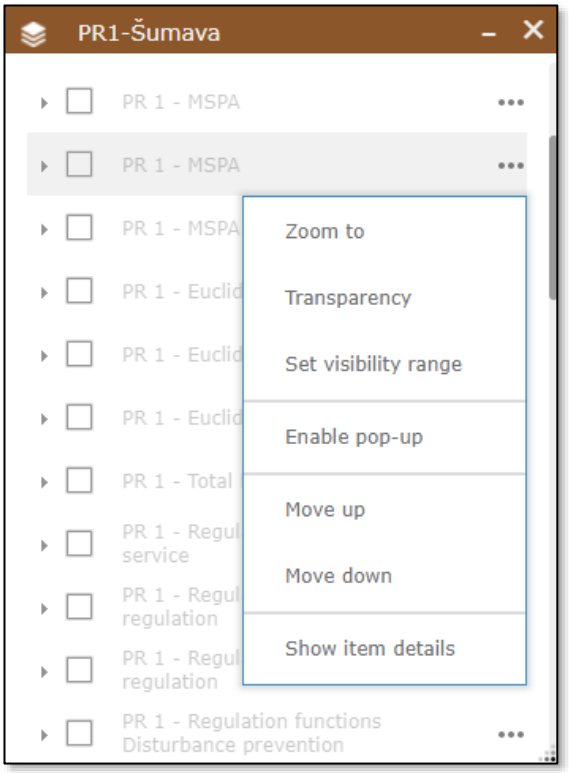

Figure 5 The Layer List of Pilot Region 1 and the layer option menu.

The three dots on the right open the layer options, which consist of various setting:

- Zoom to: shifts the current extent to the extent of the layer.
- Transparency: regulates the opacity of the layer.
- Set visibility range: adjusts the scale threshold of the layer visibility.
- *[Enable pop-up: no pop-ups available.]*
- Move up & down: puts the layer one level up or down & brings it in the fore- or background
- Show item details: retrieves further details on the data set.

Depending on the scale, different layers are becoming visible, that means, in order to see the layers of the PR you have to zoom in further or use the Bookmarks as a shortcut.

On the very top of that list are also buttons for searching specific layers and turning all layers on/off at once.

2.3 Bookmarks

The bookmarks are a handy feature to zoom in quickly to each of the 6 Pilot Regions and the Danube Region (=default view).

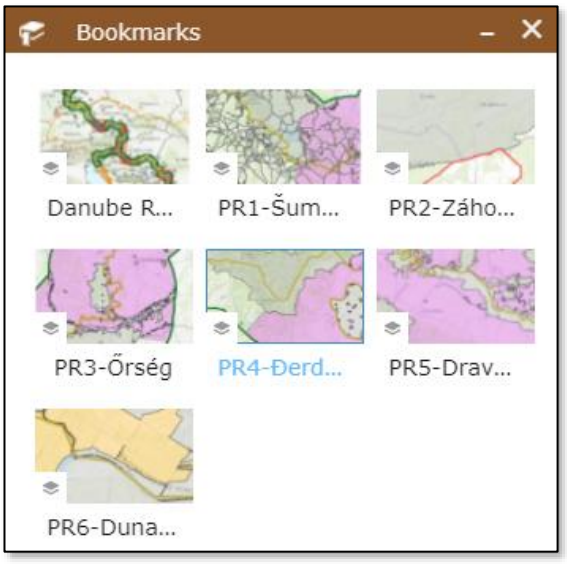

Figure 6 The Bookmarks window.

2.4 Basemap Gallery

The Basemap Gallery offers a variety of maps as base layer for the web app, such as satellite imagery, imagery hybrid, topographical, etc. that can be selected for the web app.

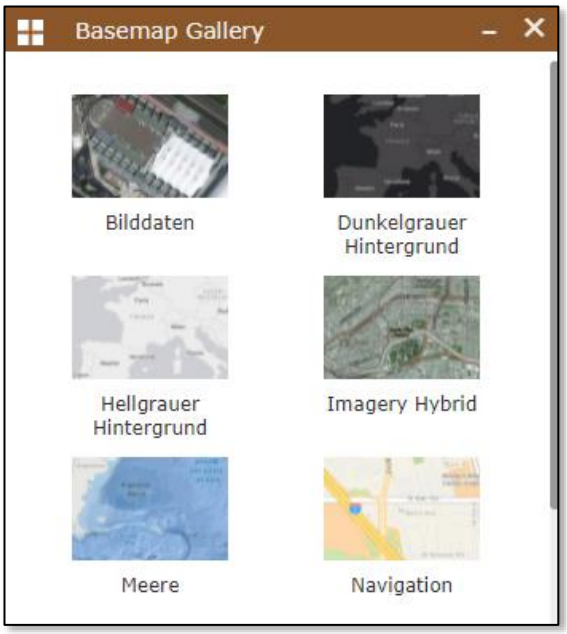

Figure 7 The Basemap Gallery.

2.5 Share

In order to send the current map extent via link, mail or social media to colleagues or even embed the tool in your website, you can use the Share function.

Especially the URL to the app can be customized in the Link options by selecting a number of parameters as shown in Figure 8. The parameters range from adding a marker to highlight important areas to setting the display language of the tool and are pretty much self-explanatory.

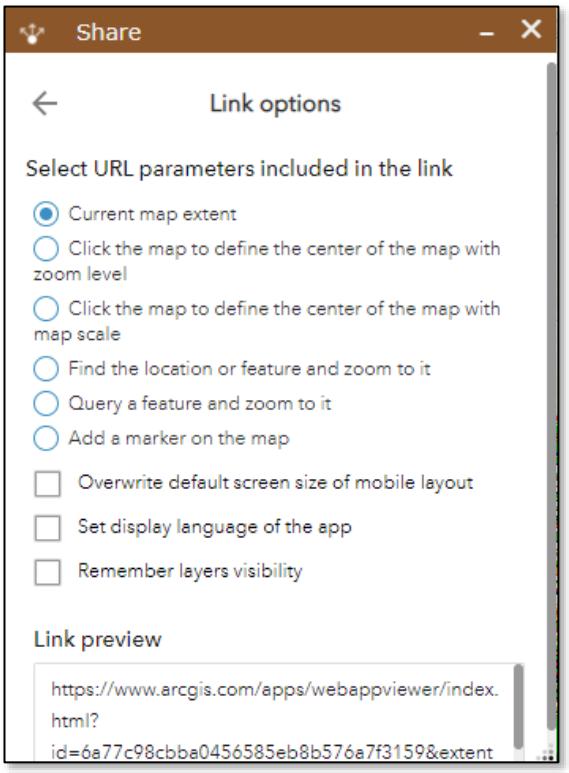

Figure 8 The different options for sharing the web app via the link.

2.6 Print

For exporting the current map extent, there are several adjustments (Figure 9) that can be done in the web app for your printing draft.

First, there is a box to name your exported map, followed by a number of layout options to fit your needs (A3, A4, Landscape, Portrait, Map only, etc.) as well as several data formats (PDF, JPG, TIFF, etc.).

By clicking the advanced options, the export can be even more refined:

- Map scale/extent: sets the method for calculating the map extent.
  Preserving map scale causes the printed map to maintain its scale while recalculating the extent around the existing center point.
  Preserving map extent causes the scale to adjust to fit the current map extent onto the printed map.
  You can also force a specific scale by clicking the Force scale option and providing a scale. Click current to populate the value with the present scale of the map.
- Output spatial reference WKID: specifies the output spatial references by a valid well-known ID (WKID), default is ESRI:102100).
- Layout metadata: specifies the Author and Copyright properties to provide current information to the print service – this **must not be overwritten.**
  Also, the legend can be switched off and the scale bar unit can be selected.

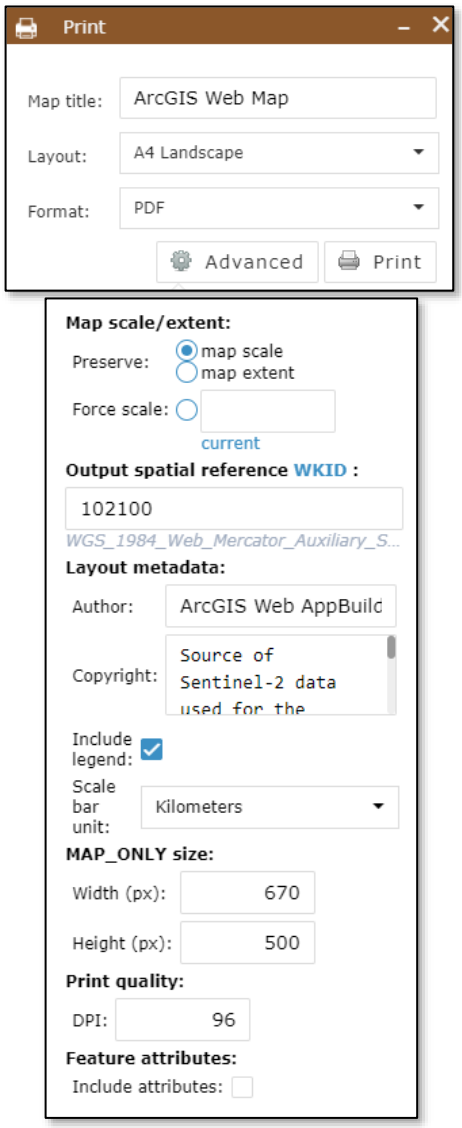

Figure 9 The Print function with the extended options for the map export.

- MAP_ONLY size: adjusts the width and height in pixels for the export of the "Map only" option. Otherwise, these values are ignored.
- Print quality: allows to adjust the resolution/DPI of the printed map.
- *[Feature attributes: This is only applicable to custom print services that use the feature attributes, which is negligible for this web app.]*

Since the legends of some layers are quite extensive, they can be found in the **Appendix**.

2.7 Integration as WMS/WMTS Service

Each of the included layers of the web app can also be integrated in your GIS software in the form of a WMS or WMTS service. This is done by selecting the Layer List of the required layer, opening the layer options and clicking on *Show item details* to get redirected to the ArcGIS Online site. Depending on the software you are using, the workflow differs a little bit from this point on:

2.7.1 ArcGIS (WMS)

In case you are using ArcGIS as the software of your choice, there is an URL for the WMS Service on the bottom right of the site that needs to be copied by simply clicking on the button right next to it (Figure 10).

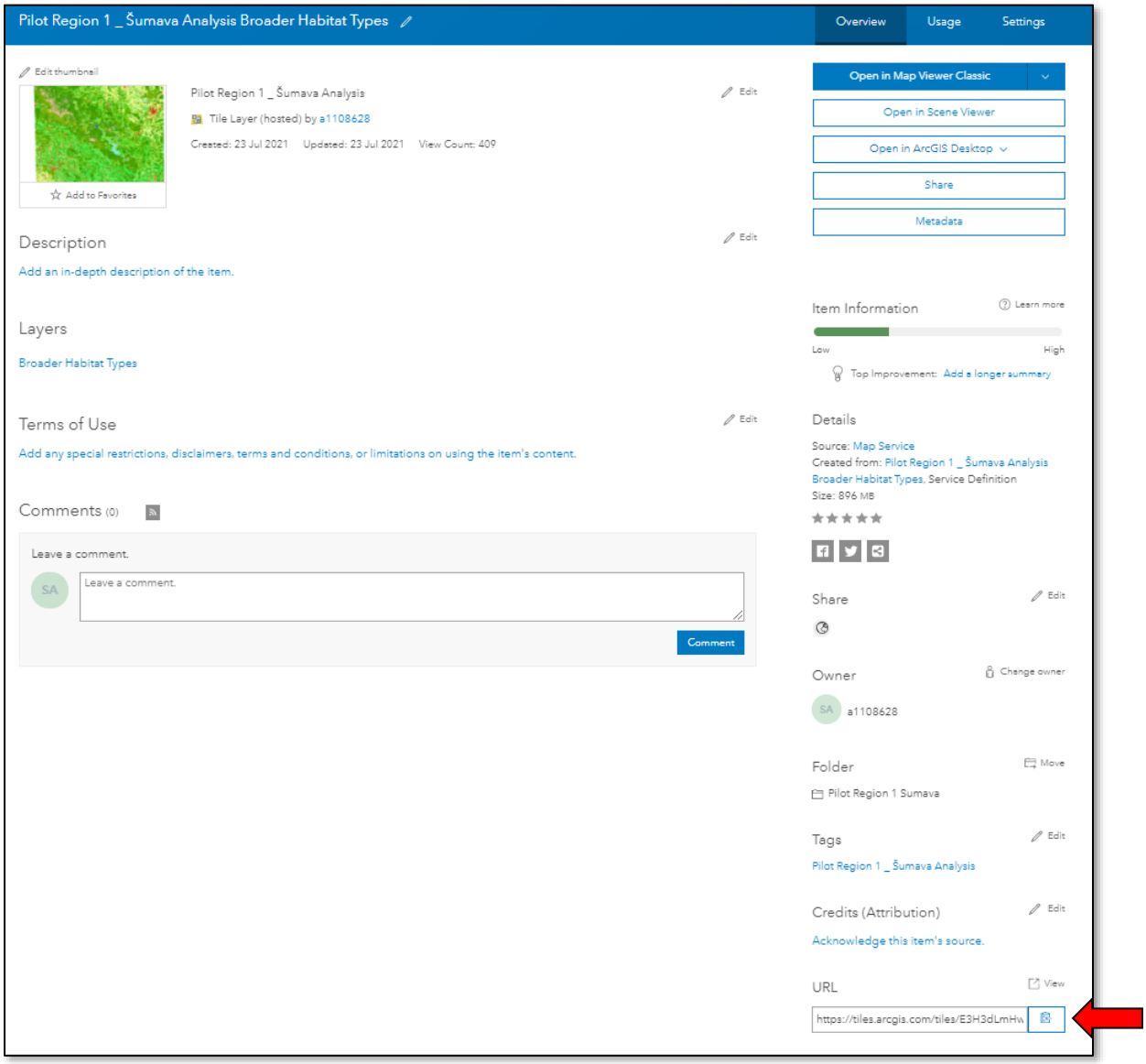

Figure 10 Overview of the item details in ArcGIS Online and the copy function of the URL.

Within your ArcGIS project, open the *File* menu and choose *ArcGIS Online…* to open the window with the search bar (Figure 11) filtering for Maps and Data (default). Now paste the URL of your target layer in there and add the search result to your project.

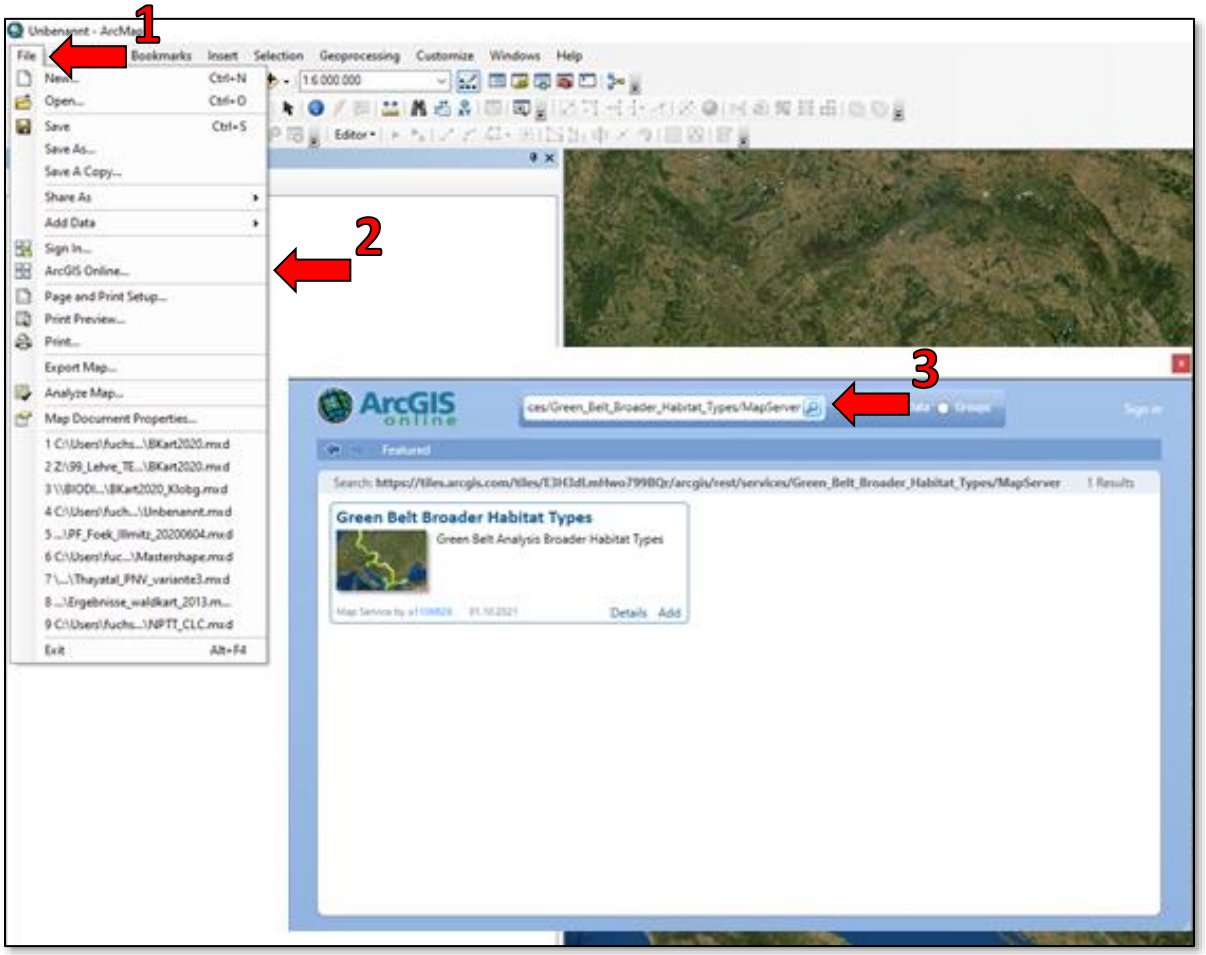

Figure 11 Workflow of importing the BHT of the EGB as a WMS map in ArcGIS.

2.7.2 QGIS (WMTS)

If you prefer working with QGIS, you have to click on the *View* button next to the URL field in order to see the Services Directory and open the *WMTS* site (Figure 12). Copy the link of that site for the next step.

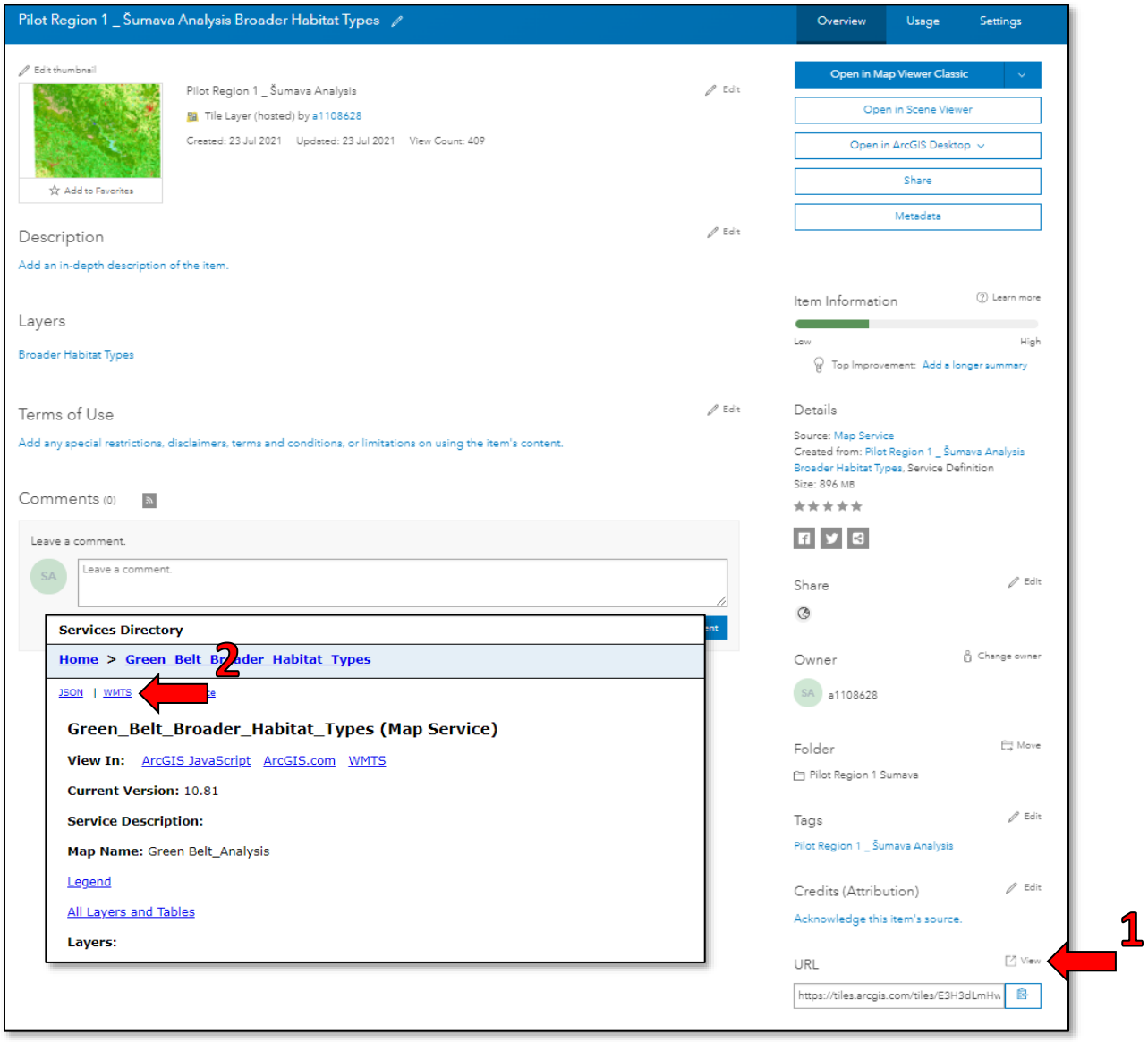

Figure 12 Overview of the item details in ArcGIS Online, the 'view' function and the Services Directory site.

In your QGIS project you have to *Add WMS/WMTS Layer*, click on *New* and paste the link in the right field. After naming your layer, click *OK* and *Connect* to the new WMTS Service. The next window will show you the available Tile sets. Eventually, add that layer to your project. (Figure 13)

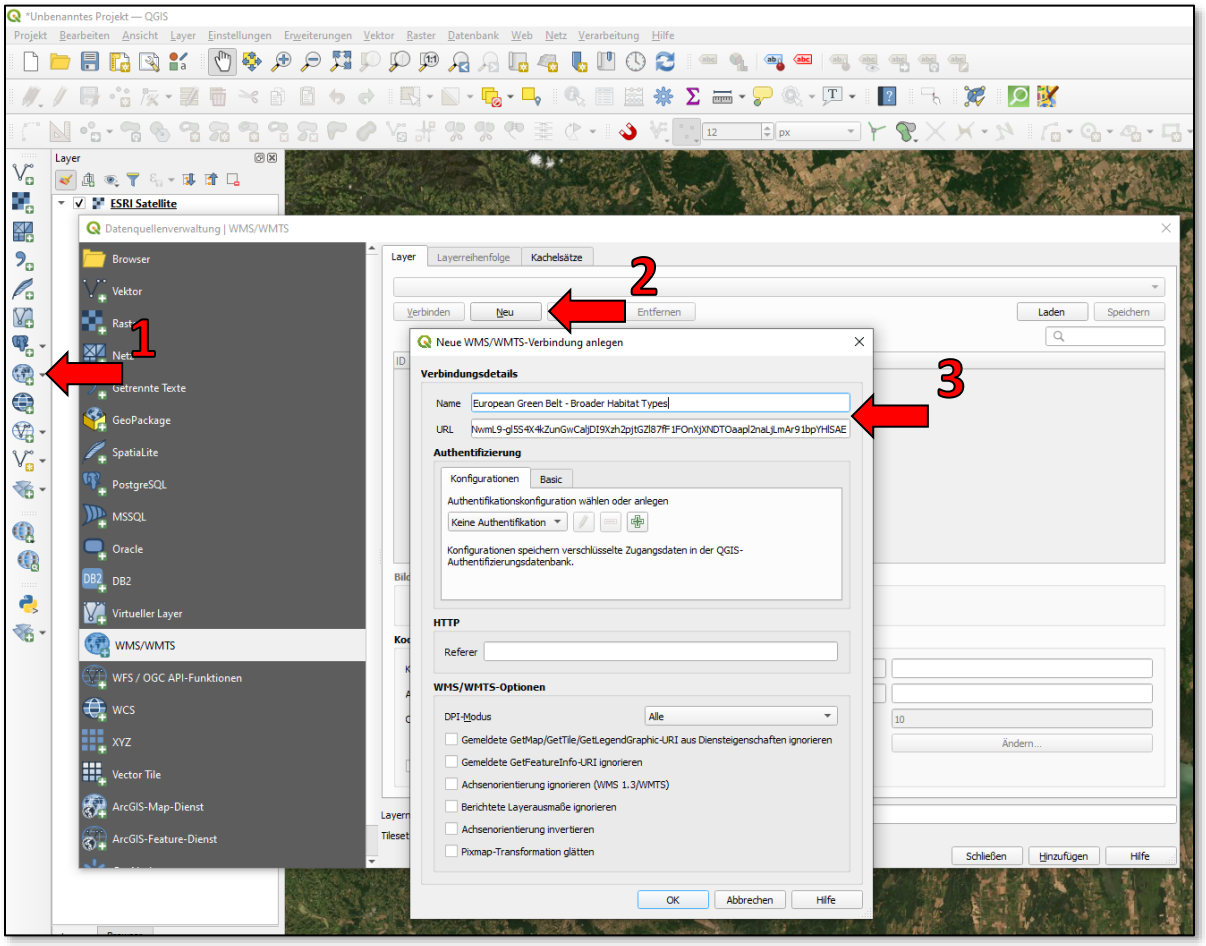

Figure 13 Workflow of importing the BHT of the EGB as a WMTS map in QGIS.

2.8 Citation

Since the space for references is quite limited in the ArcGIS Web App, the correct citation suggested in this manual's chapter is **crucial for the usage of the maps and data retrieved via the GIS tool!**

More precisely, there are two main point that need to be included with the exported maps:

1) Logo banner:
   Please append the graphic in Figure 14 to the exported map extent to ensure the required reference to the institutions, especially the EU.

Figure 14 Logo banner for citation.

2) Citation of the project & geo data sources:
   The suggested citation for the content of the GIS tool as well as the geodata sources for the analyses of the project can be found below.

   GIS Tool:
   Fuchs S., Wrbka T. (2021): User-friendly GIS tool. Elaborated within the Interreg DTP Project "DaRe to Connect". Using: ArcGIS Web App Builder. Produced by University of Vienna, Dept. of Botany and Biodiversity Research and by SynerGIS Informationssysteme GmbH, November 2021, Vienna. URL from the 30.11.2021: https://univie.maps.arcgis.com/apps/webappviewer/index.html?id=6a77c98cbba0456585eb8b576a7f3159

   Geodata:
   European Environment Agency (EEA) (2012): EUNIS habitat classification - Ecosystem types of Europe 2012 - Full map (marine and terrestrial habitats) - version 3 revision 1, Feb. 2019. Retrieved from https://www.eea.europa.eu/data-and-maps/data/ecosystem-types-of-europe-1#tab-data
   European Space Agency (ESA) (2019): Copernicus Sentinel data of 2017 & 2018. Retrieved from https://scihub.copernicus.eu/

3. References

Bunce R.G.H., Bogers M.M.B., Roche P., Walczak M., Geijzendorffer I.R., Jongman R.H.G. (2011): Manual for Habitat and Vegetation Surveillance and Monitoring: Temperate, Mediterranean and Desert Biomes. First edition. Wageningen, Alterra report 2154.
Retrieved from https://www.wur.nl/en/Publication-details.htm?publicationId=publication-way-343035313431, 30.11.2021

Bunce R.G.H., Metzger M.J., Jongman R.H.G., Brandt J., de Blust G., Elena-Rossello R., Groom G.B., Halada L., Hofer G., Howard D.C., Kovar P., Mucher C.A., Padoa-Schioppa E., Paelinx D., Palo A., Perez-Soba M., Ramos I., Roche P., Skanes H., Wrbka T. (2008): A standardized procedure for surveillance and monitoring European habitats and provision of spatial data. Landscape Ecol. 23, 11–25.
Retrieved from http://dx.doi.org/10.1007/s10980-007-9173-8, 30.11.2021

de Groot R. S. (2006): Function-analysis and valuation as a tool to assess land use conflicts in planning for sustainable, multifunctional landscapes. Landscape and Urban Planning 75:175-186.
Retrieved from http://dx.doi.org/10.1016/j.landurbplan.2005.02.016, 20.11.2021

de Groot R. S., Alkemade R., Braat L., Hein L., Willemen L. (2010): Challenges in integrating the concept of ecosystem services and values in landscape planning, management and decision making. Ecological Complexity 7:260-272.
Retrieved from http://dx.doi.org/10.1016/j.ecocom.2009.10.006, 20.11.2021

de Groot R. S., Wilson M. A., Boumans R. M. J. (2002): A typology for the classification, description and valuation of ecosystem functions, goods and services. Ecological Economics 41(3):393-408.
Retrieved from http://dx.doi.org/10.1016/S0921-8009(02)00089-7, 20.11.2021

European Environment Agency (EEA) (2012): EUNIS habitat classification - Ecosystem types of Europe 2012 - Full map (marine and terrestrial habitats) - version 3 revision 1, Feb. 2019.
Retrieved from https://www.eea.europa.eu/data-and-maps/data/ecosystem-types-of-europe-1#tab-data, , 24.11.2021

European Space Agency (ESA) (2019): Copernicus Sentinel data of 2017 & 2018. Retrieved from https://scihub.copernicus.eu/, 24.11.2021

Millennium Ecosystem Assessment (MEA) (2005): Ecosystems and Human Well-being: Synthesis. Island Press, Washington, DC.

Soille P. & Vogt P. (2009): Morphological segmentation of binary patterns. Pattern Recognition Letters 30(4): 456-459.
Retrieved from https://dx.doi.org/10.1016/j.patrec.2008.10.015, 20.11.2021

Stoll S., Frenzel M., Burkhard B., Adamescu M., Augustaitis A., Baeßler C., Boneth F.J., Carranza M.L., Cazacu C., Cosor G.L., Díaz-Delgado R., Grandin U., Haase P., Hämäläinen H., Loke R., Müller J., Stanisci A., Staszewski T., Müller F. (2015): Assessment of ecosystem integrity and service gradients across Europe using the LTER Europe network. Ecological Modelling, Volume 295, Pages 75-87.

Retrieved from https://doi.org/10.1016/j.ecolmodel.2014.06.019, 20.11.2021

TEEB (2010): The Economics of Ecosystems and Biodiversity: Mainstreaming the Economics of Nature: A synthesis of the approach, conclusions and recommendations of TEEB.

Vogt P. & Riitters K. (2017): GuidosToolbox: universal digital image object analysis. European Journal of Remote Sensing, 50(1): 352-361.

Vogt P., Riitters K. H., Iwanowski M., Estreguil C., Kozak J. & Soille P. (2007): Mapping landscape corridors. Ecological Indicators, 7(2): 481-488.

Wickham J. D., Riitters K. H., Wade T. G. & Vogt P. (2010): A national assessment of green infrastructure and change for the conterminous United States using morphological image processing. Landscape and Urban Planning, 94(3-4): 186-195.

4. List of Figures

5. Appendix

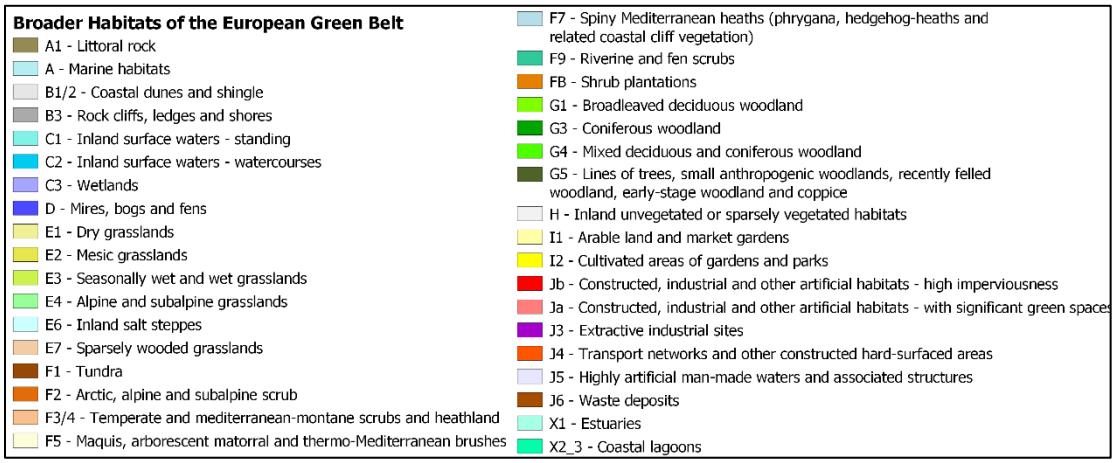

Figure 15 Legend of the Broader Habitat Types of the European Green Belt.

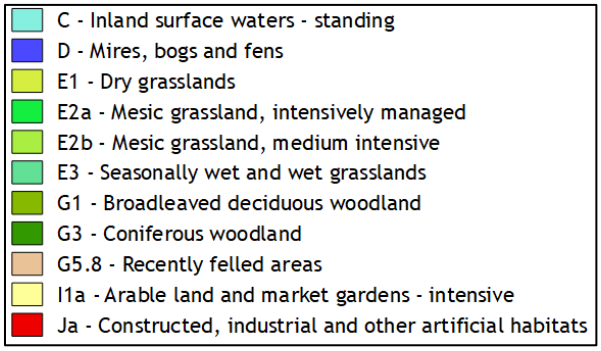

Figure 16 Legend of the Broader Habitat Types of Pilot Region 1.

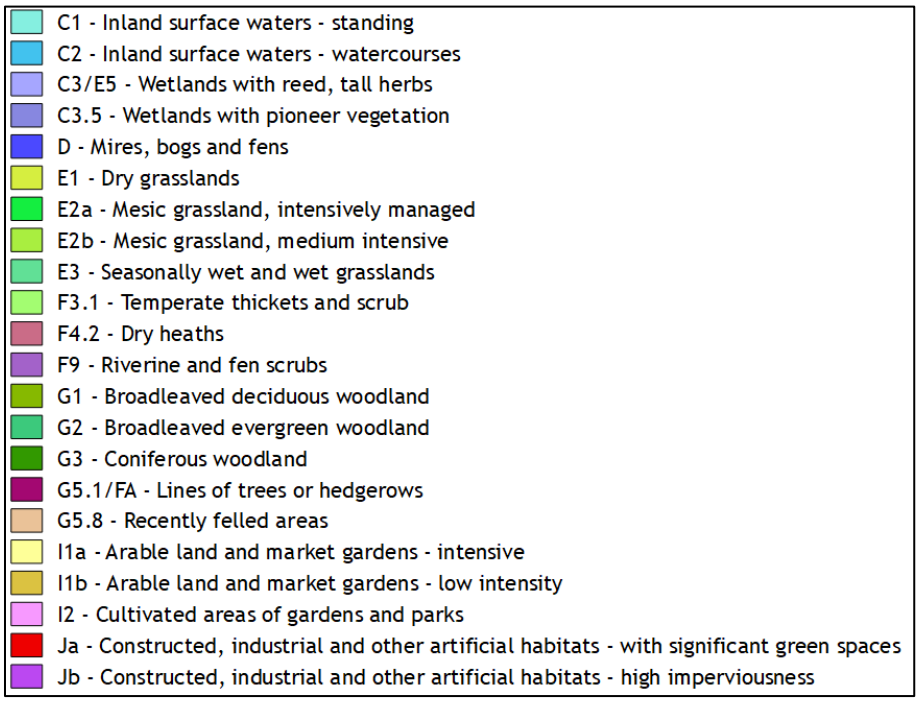

Figure 17 Legend of the Broader Habitat Types of Pilot Region 3.

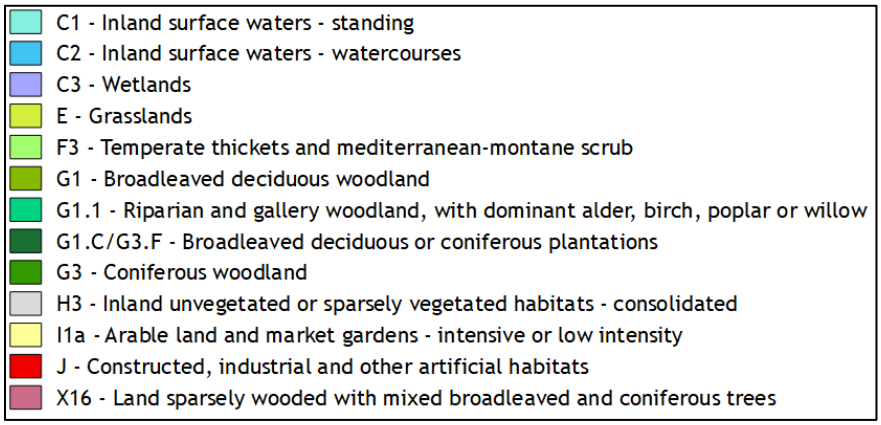

Figure 18 Legend of the Broader Habitat Types of Pilot Region 4.

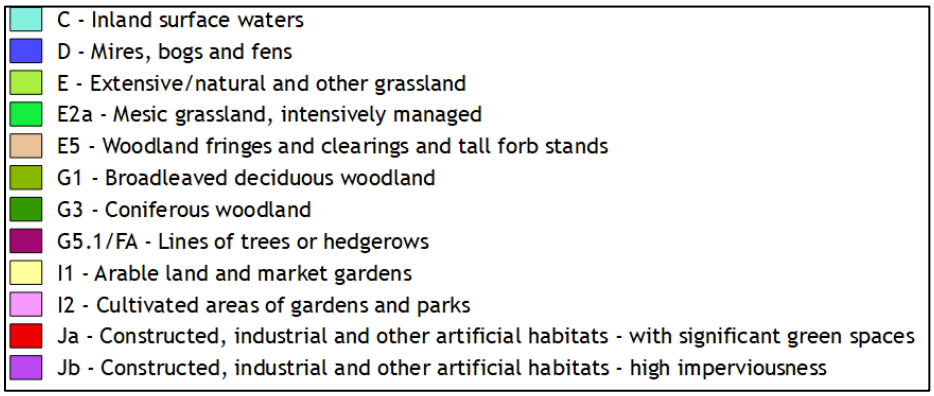

Figure 19 Legend of the Broader Habitat Types of Pilot Region 5.

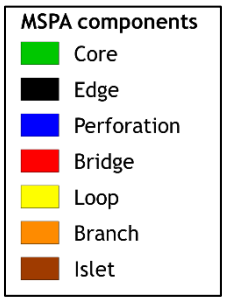

Figure 20 Legend of the MSPA components.

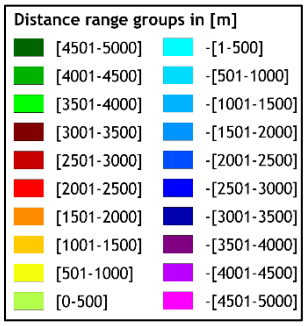

Figure 21 Legend of the distance ranges of the Euclidean Distance for the European Green Belt.

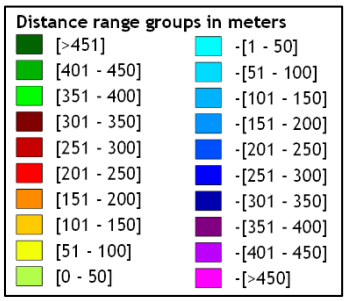

Figure 22 Legend of the distance ranges for the Pilot Regions.

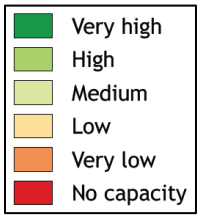

Figure 23 Legend for the Ecosystem Services.

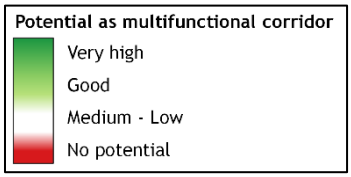

Figure 24 Legend for the Connectivity-Functionality Index.