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AND NATURAL HABITATS

Group of Experts on Protected Areas and Ecological Networks

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TRANSFER OF NATIONAL DATA TO PAN-EUROPEAN 10X10 KM GRID FOR NON-EU CONTRACTING PARTIES TO THE BERN CONVENTION
- GUIDANCE DOCUMENT -

Document prepared by
the European Topic Centre on Biological Diversity

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1. BACKGROUND & INTRODUCTION

This document shall provide workflow descriptions of how countries can transfer their national data into the pan-European 10x10km grid used by the European Environment Agency (EEA) and other authorities.

1.1 Background

In the framework of the Bern Convention countries are asked to report national distribution information using the 10x10km grid. The national data can then be used in parallel to the data collection on species/habitat distributions produced by the EEA member countries to show a full European coverage on the distribution of species and habitats.

In order to have a harmonised underlying system the EEA/Council of Europe provides country specific grids for all countries that are members of the EEA or the European Neighbourhood Initiative. These country specific grids are excerpts from the pan-European grid spanning the European continent. The continuous grid system allows for integration of national data without gaps using the same resolution and therefore allowing comparability of data for the whole area covered.

1.2 Grid description

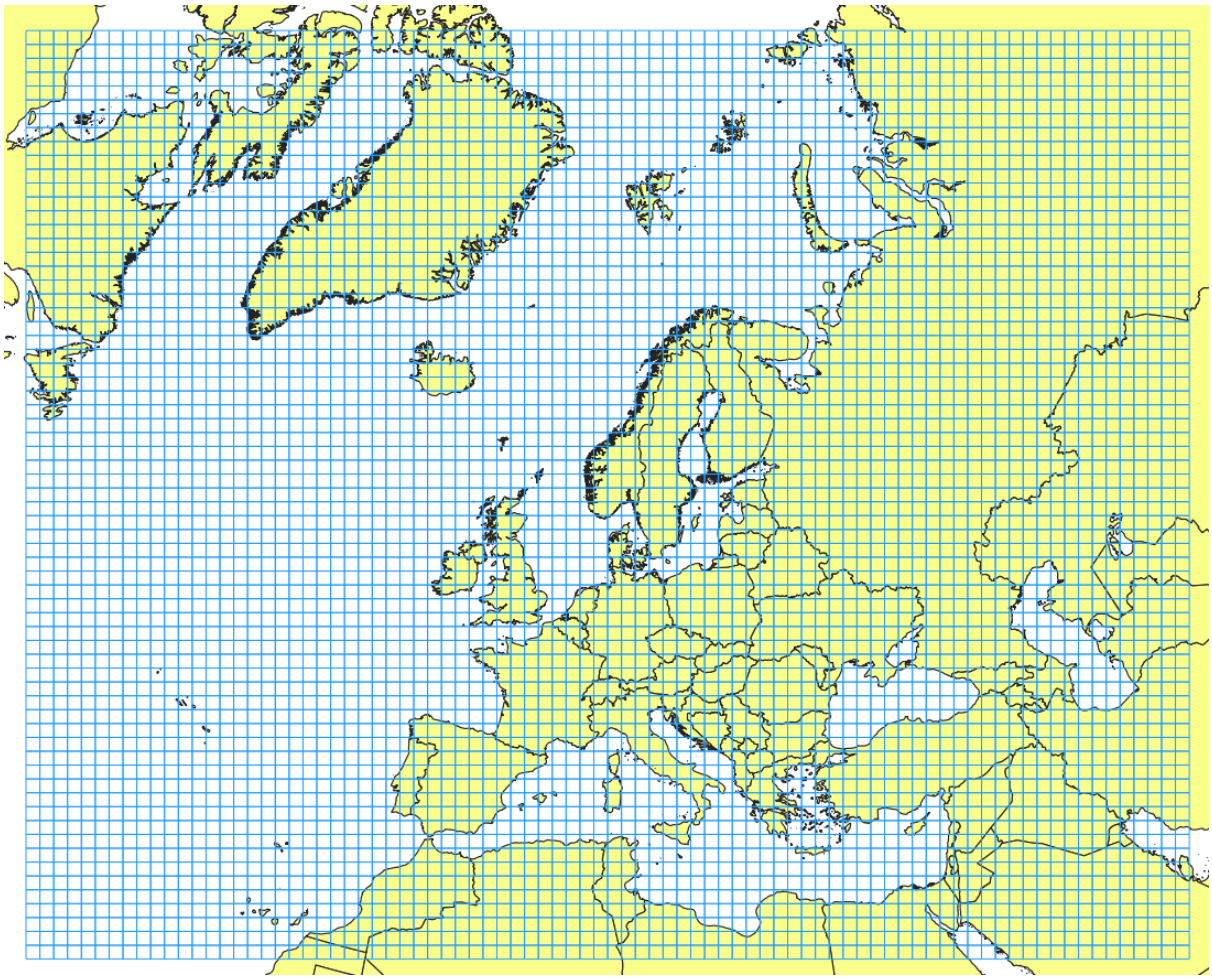
The Pan-European grid has been developed to create a reference grid system spanning the whole territory of Europe which features a true area representation for all parts. This is especially important for the calculation of protected areas or the extent of species and habitat distributions to allow for statistically reliable calculations.

Therefore the coordinate reference system ETRS89/LAEA (European Terrestrial Reference System 1989 geodetic reference frame combined with Lambert Azimuthal Equal Area projection) defined by epsg:3035[1] has been used as a base for the grid system. The westernmost extent chosen is the western limit of the epsg:3035 coordinate reference system while the southern limit has been defined approx. 200km south of the Canaries.

To the east large parts of Russia as well the Caspian Sea are covered.

By this the whole European territory with all Member States of the EEA along with EEA cooperating countries to the East are enclosed by the grid system as shown in Map 1.

[1] http://epsg-registry.org/?display=entity&urn=urn:ogc:def:crs:EPSG::3035



Map 1: Coverage of the Pan-European Reference Grid systems

For different purposes and scales of analyses different grid mesh sizes have been implemented allowing the selection of the appropriate grid cell size based on the demands or availability of input data. The most commonly used grid systems are 1 km, 10 km or 100 km cells. All Pan-European grids are accessible through the EEA Reference Grid collection in the SDI data catalogue[2] (EEA member states) or the ENI-SEIS II webpage by the Council of Europe[3].

The grid cells are attributed based on the location in the European grid.

All cell codes defining a name for the cells are referring to the lower left boundary of the ETRS89/LAEA projection.

So cell codes are constructed of three segments as shown below (Figure 0-1):

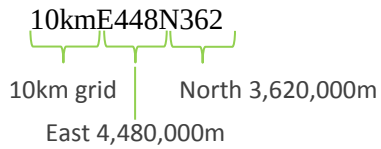


Figure 0-1: Example of cell naming by cell code

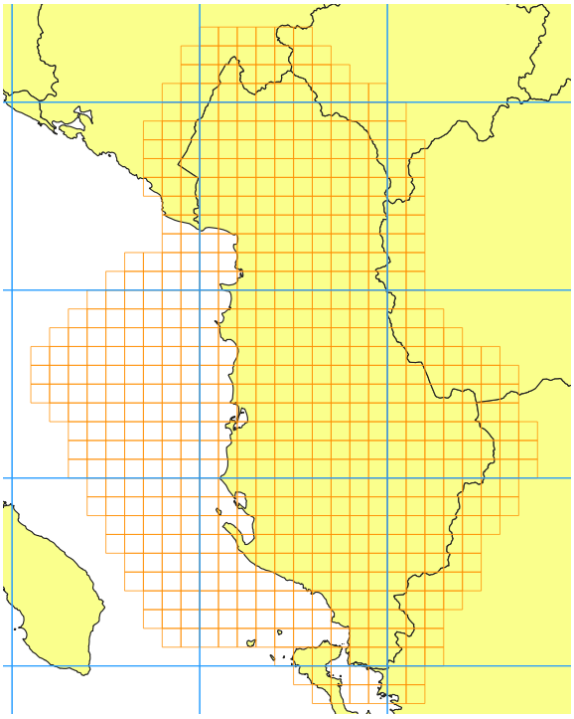
1.3 Reporting of species and habitat distribution and related technical requirements

In the framework of the Bern Convention involved countries are asked to report their data on distribution information utilising the European 10x10km grid.

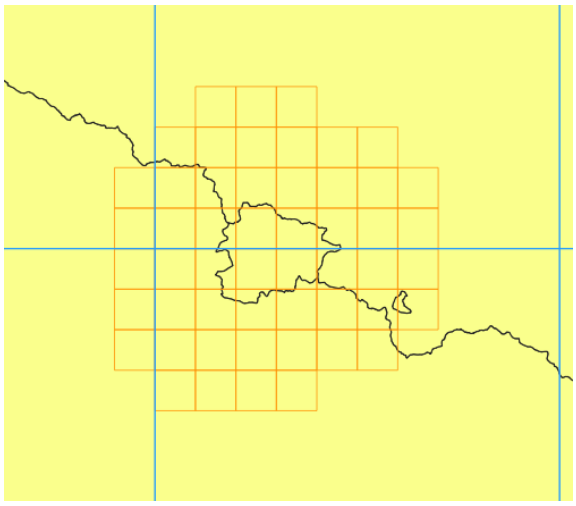
[2] https://www.eea.europa.eu/data-and-maps/data/eea-reference-grids-2#tab-gis-data
[3] https://www.coe.int/en/web/bern-convention/-/workshop-on-reporting-under-res-8-2012-

EEA/EC provide country specific grids which have been taken from the Pan-European 10km grid for all countries that are part of the ENI-SEIS II project or member state in the EEA. To allow for more coherent border connection and avoiding loss of species or respectively habitat information all country specific grids contain a 20km buffer surrounding the country borders. When reporting species information countries can make sure all their collected information will be included also in cases where due to the use of a higher resolution country border a grid cell might fall outside the EEA country border.

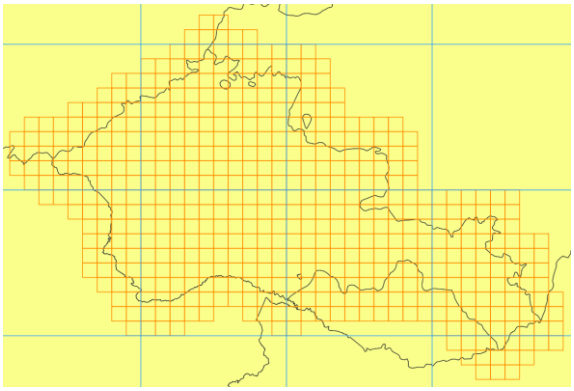
Below the 10x10km grids for the ENI-SEIS II countries and other countries not being subject to the EU Nature Directives reporting are visualized. All grids shown can be downloaded from the Council of Europe website.



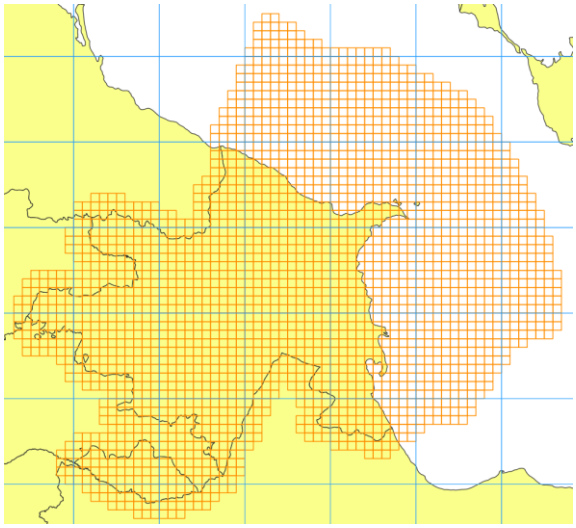
Albania



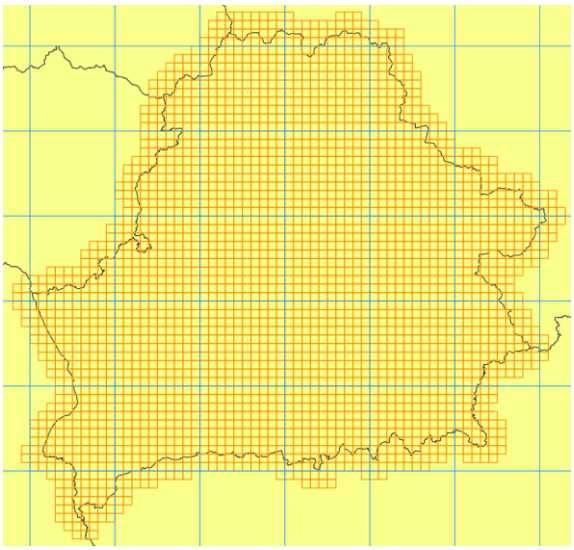
Andorra



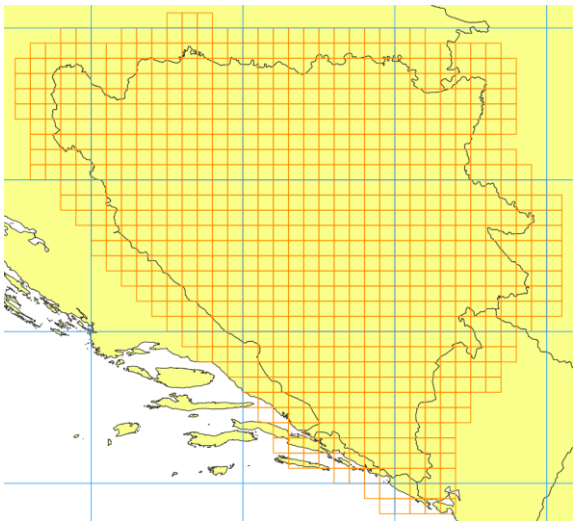
Armenia



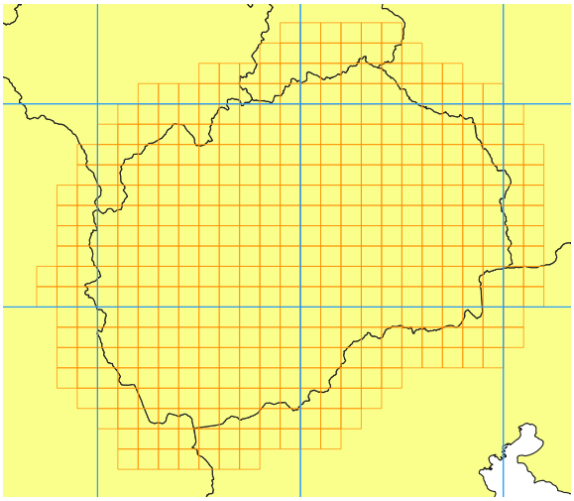
Azerbaijan



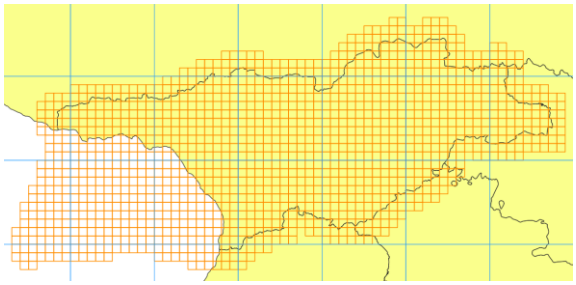
Belarus



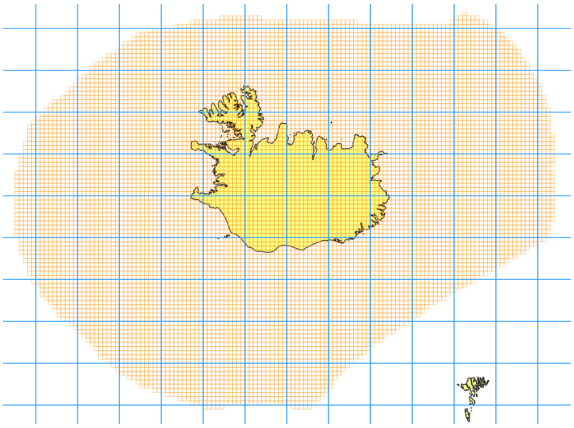
Bosnia and Herzegovina



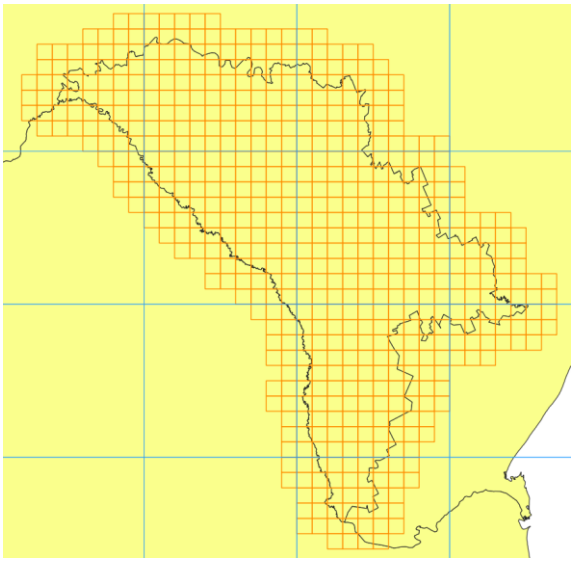
“The former Yugoslav Republic of Macedonia”



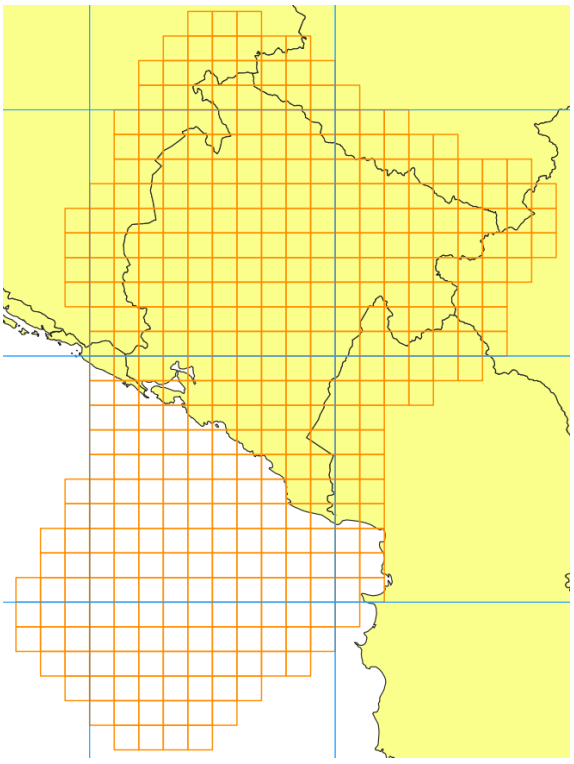
Georgia



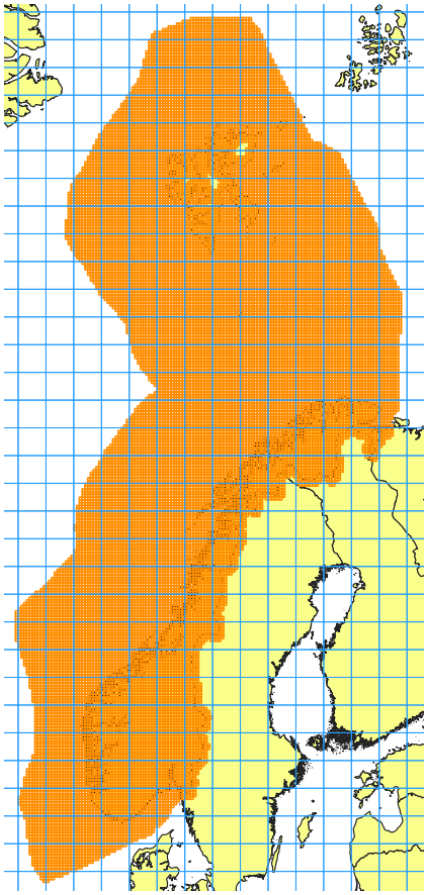
Iceland



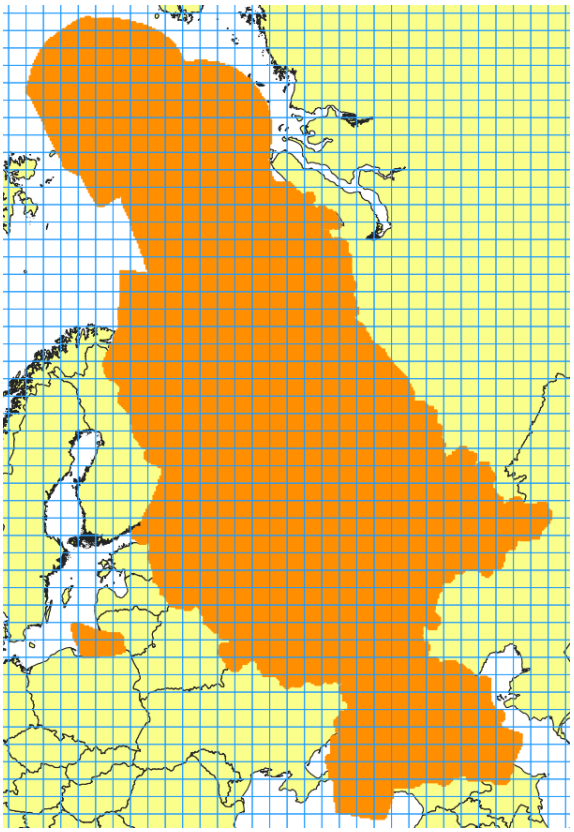
Republic of Moldova



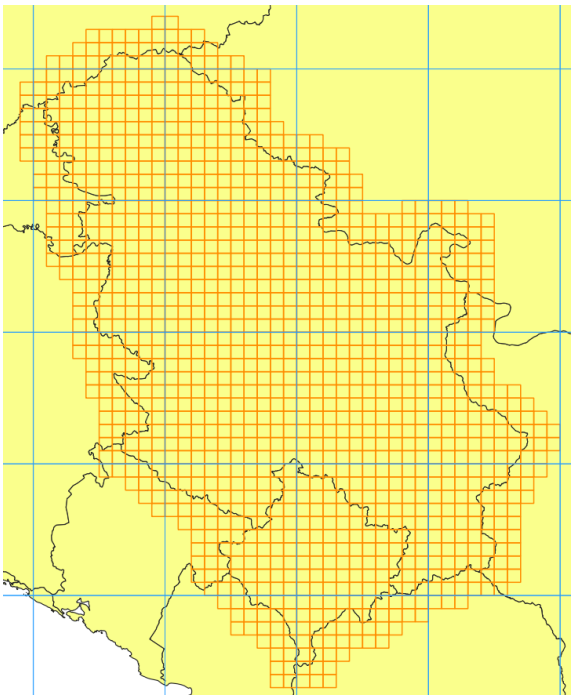
Montenegro



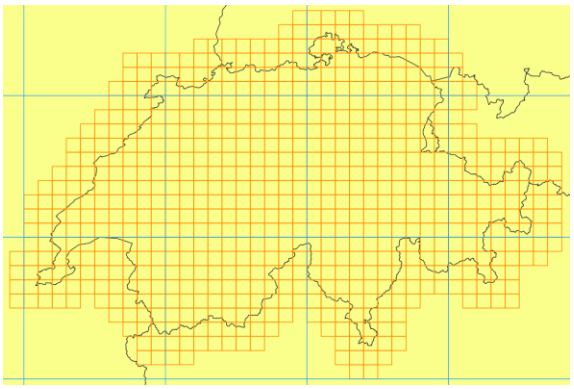
Norway



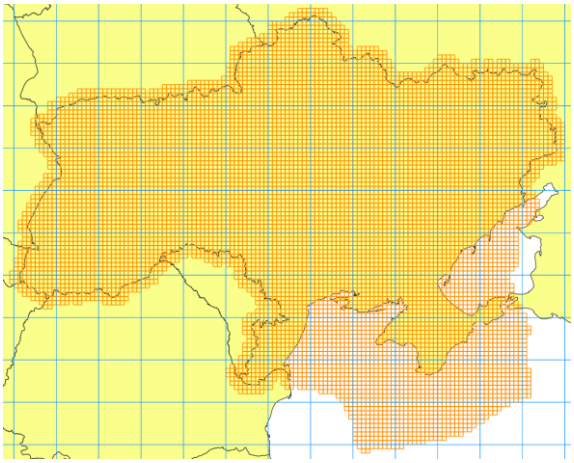
Russian Federation



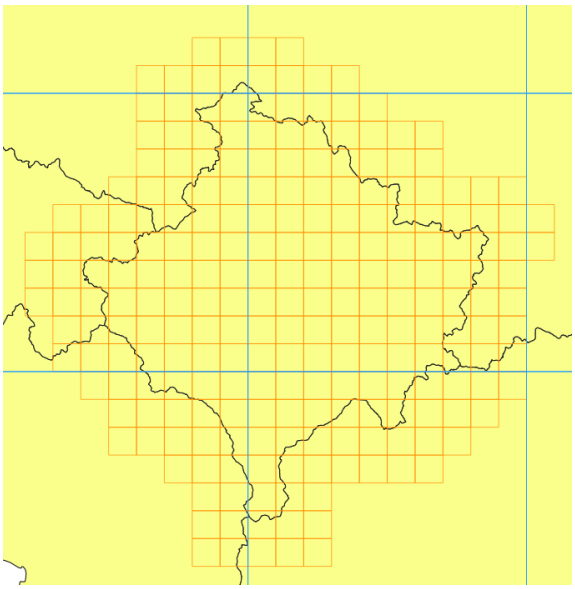
Serbia



Switzerland



Ukraine



Kosovo*

Figure 0-2: national 10 x 10 km country grids

2. TRANSFER OF NATIONAL DATA TO PAN-EUROPEAN GRID SYSTEM

2.1 Data requirements

Input data on species or habitat distribution must be described by polygon, point, line or gridded spatial datasets in order to link the distribution information collected to the corresponding grid cells.

* All reference to Kosovo, whether to the territory, institutions or population, in this text shall be understood in full compliance with United Nations Security Council Resolution 1244 and without prejudice to the status of Kosovo.

To avoid displacement and shifts between the actual position based on national coordinate reference systems and the grid cells the national data has to be reprojected to the European projection ETRS89/LAEA before linking to the grids.

2.2 Data preparation

In preparation for the reporting on species and habitat distribution the national data has to be transferred into the required report format.

For all species and habitats the appropriate code representing the species or habitat type must be provided as part of the attributes for each spatial element (polygon, point, line or grid cell).

Figure 0-1 below shows the standard structure of distribution data on species and habitats.

Figure 0-1: attribute structure of habitat and species distribution data

Name	Description	TYPE	Example
code	The Unique identifier. Use the code given in the checklist for reporting	string(15)	*1530*
maptype	Distribution	string(15)	*Distribution*
category	Habitats/Species	string(15)	*Habitats*
isocode	Country code:	string(2)	*AT*
refgrid	Information about EEA GRID used and its mesh size such as 10x10km, 1x1km, …	string(25)	*EEA-10km GRID*
sensitive	Description if data contains sensitive information "sensitive" or "non-sensitive"	string(15)	*sensitive*

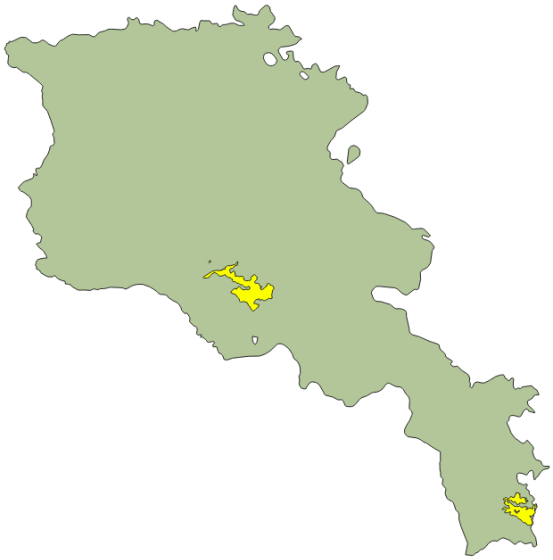
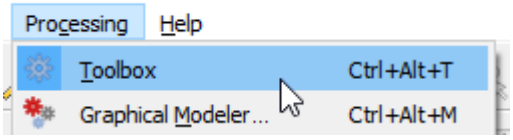
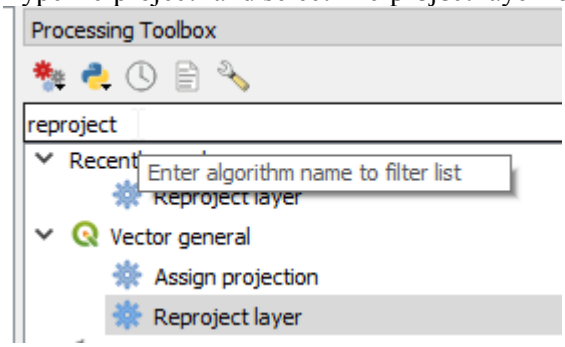
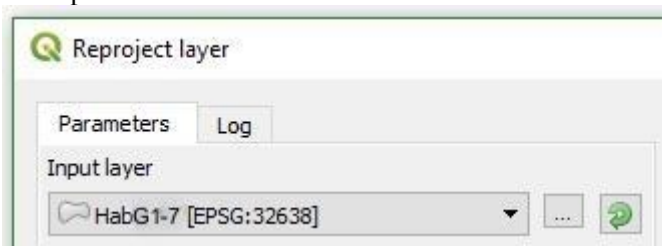
2.3 Data re-projection

As described before data has to be transferred into the European projection before the linkage to the grid cells. National coordinate reference systems often consist of very country-specific parameters in describing the orientation and position of the nationally established coordinate frame. Therefore, the transfer into the European coordinate reference system (CRS) might be a complex task to be carried out by the geographical information system (GIS). Although most of the common GIS software suites are capable of transferring data 'on-the-fly' - meaning by directly using the initial country CRS on one site (input data) and the European CRS on the other site (grid system) in the same maps – the EEA recommends the re-projection of national data. This is especially the case for complex national CRS which are built specifically for one country as often the translation into the common European CRS EPSG89/LAEA requires difficult computations to recalculate the input coordinates as part of the distribution data in the European projection. The 'on-the-fly' method in many cases only estimates the position of major coordinates to display the input data in the European CRS.

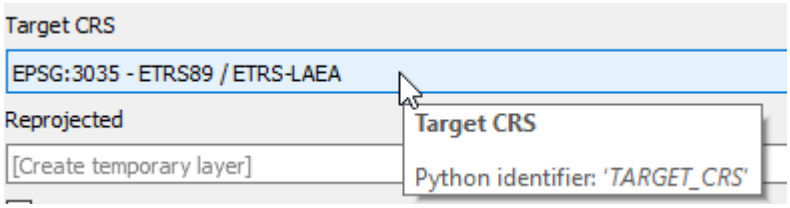
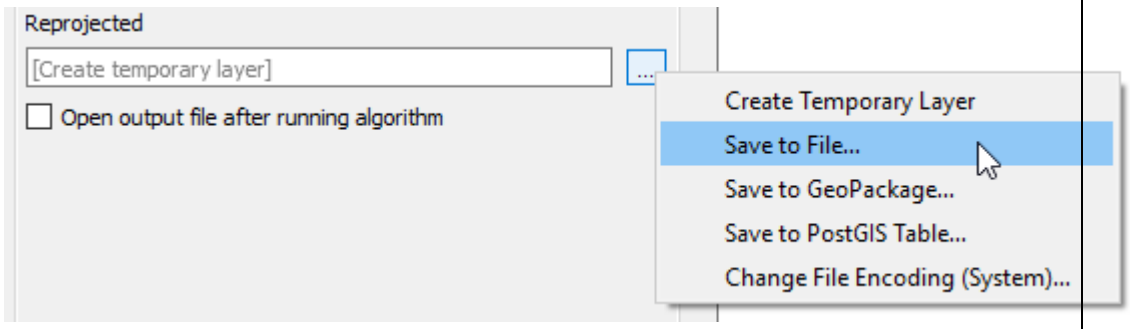
When using the input data directly with the original CRS, the significant risk of displacements is accepted, resulting in potentially wrong positions of the data in the European grid. Even small displacements in the range of a few meters can result in non-linking or the erroneous linking of distribution information to a cell.

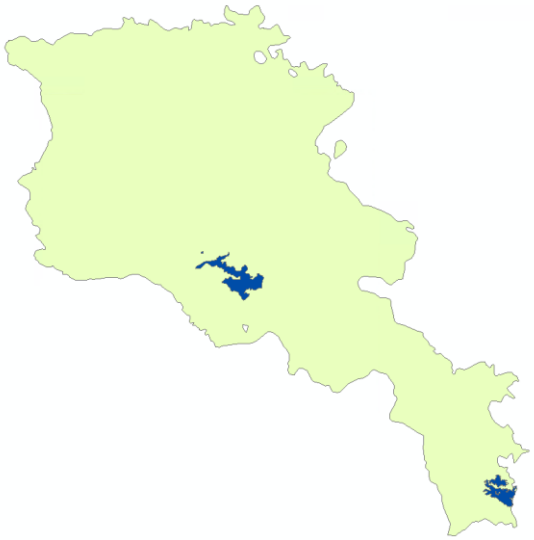
To reduce the risk of such shifts and displacements as a result of incorrect or incomplete transformation of coordinates countries are asked to perform a re-projection on their data before combining with the grids.

Depending on the GIS software package used the task of re-projecting the data has slightly different workflows. The figures below show the necessary steps for the two most common data packages QGIS (v3.0.3) and ArcGIS (v10.6):

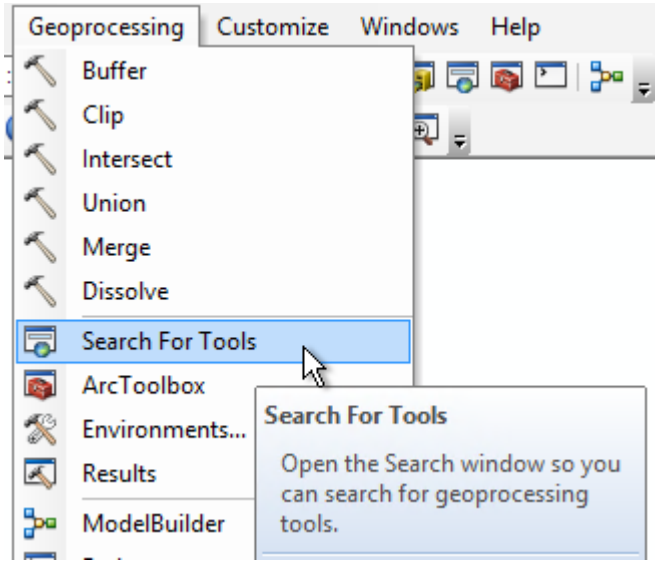
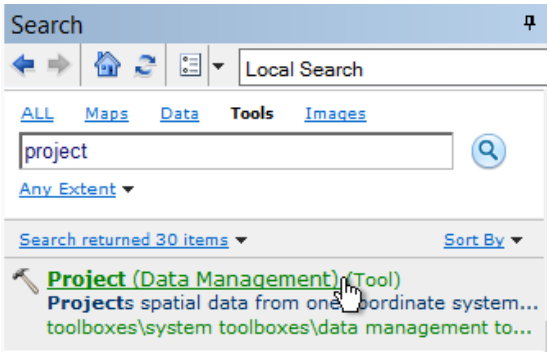
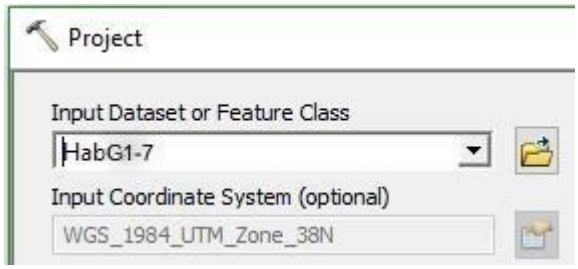
QGIS	
Input:	State_Reserves.shp → renamed to G1-7.shp as sample data for this guideline → data on state reserves in Armenia[4] using epsg:32638 (WGS 84 / UTM zone 38N) assuming state reserves represent habitat distribution for Thermophilous deciduous woodland (habitat code: G1.7) 
1	Open 'Processing Toolbox' 
2	Type 're-project' and select 'Re-project layer' by double-click 
3	Select national data to be reprojected Example: 

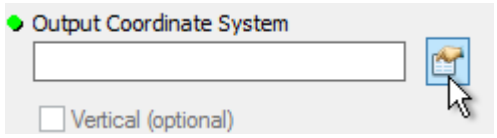
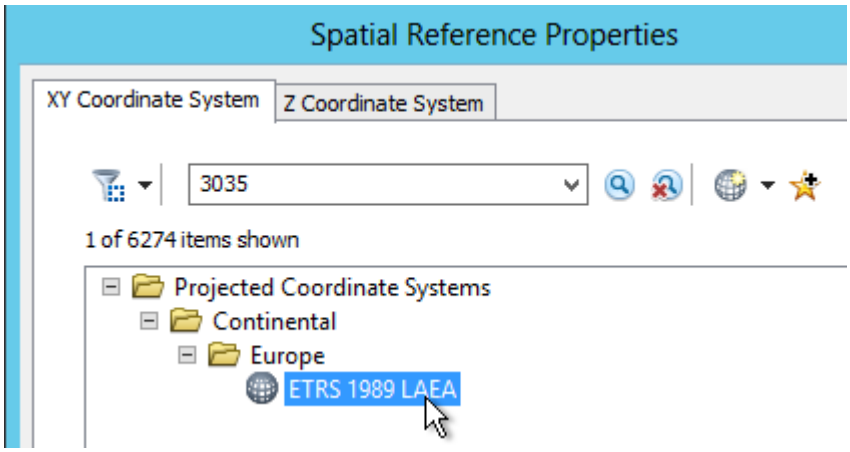
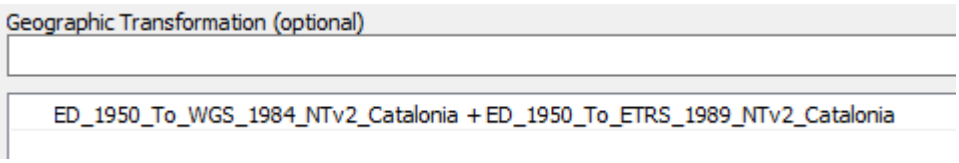
[4] AUA Acopian Center for the Environment (http://ace.aua.am/gis-and-remote-sensing/vector-data/)

4	Select EPSG:3035 as target CRS 
5	Select File as output 
6	Define output path of reprojected national data e.g. originalName_3035.shp 

ArcGIS	
Input:	State_Reserves.shp → renamed to HabG1-7.shp for this guideline as sample data → data on state reserves in Armenia[5] using epsg:32638 (WGS 84 / UTM zone 38N) assuming state reserves represent habitat distribution for Thermophilous deciduous woodland (habitat code: G1.7) 

[5] AUA Acopian Center for the Environment (http://ace.aua.am/gis-and-remote-sensing/vector-data/)

1	Open ‘Search For Tools’ 
2	Type ‘project’ in search window and start search with magnifying glasses
3	Select ‘Project (Data Management)’ from tool list 
4	Select national data to be reprojected Example: 
5	Define output path of reprojected national data e.g. originalName_3035.shp 
6	Open list of CRS by clicking

	
7	Type 3035 in search bar and press enter Select EPSG:3035 as Output Coordinate System 
8	Geographic transformation is filled automatically or has to be selected from drop down Example: 
	'Preserve Shape' does not have to be turned on

2.4 Data transfer into grid

After the national data has been re-projected in the initial data preparation the distribution information can be transferred into the respective European grid i.e. the country excerpt of the full European grid.

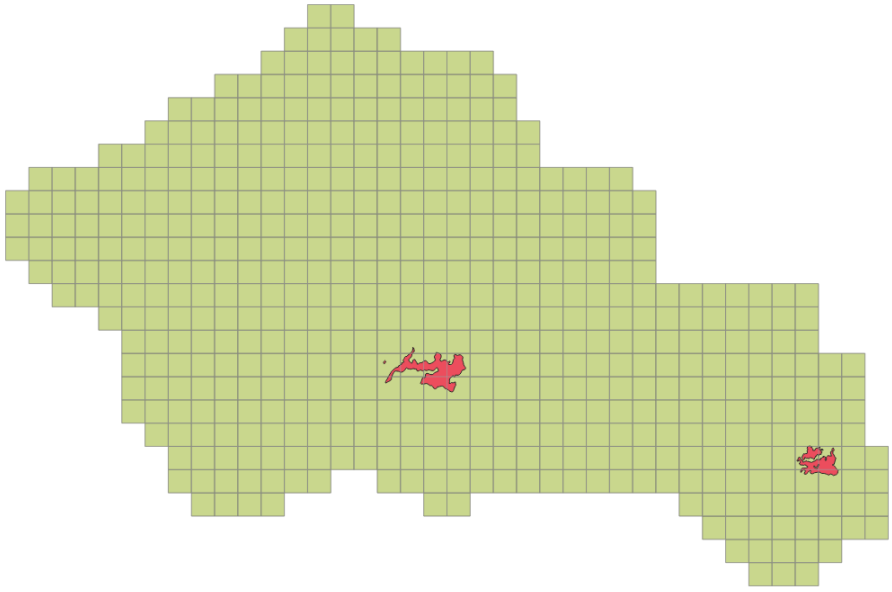
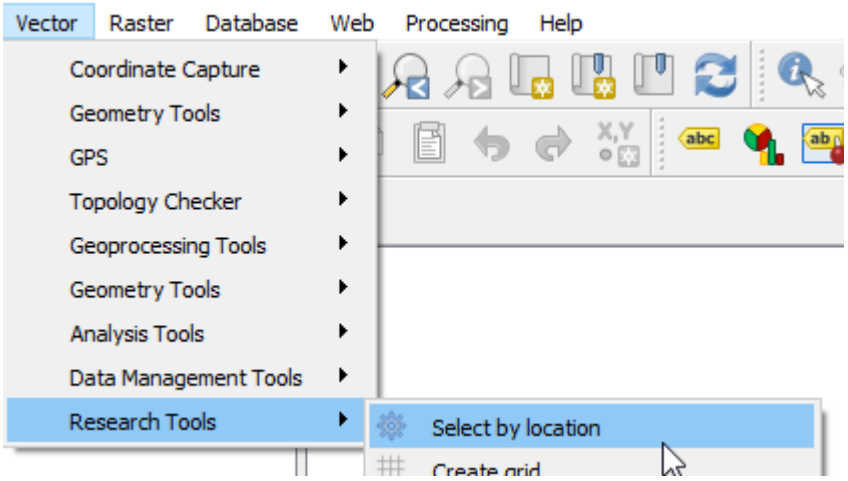
In order to link the data to the grid cells the methodology depends on the type of input data.
The following sections will describe the necessary steps for

- Polygon distribution information
- Point distribution information
- Linear distribution information
- Grid based distribution information

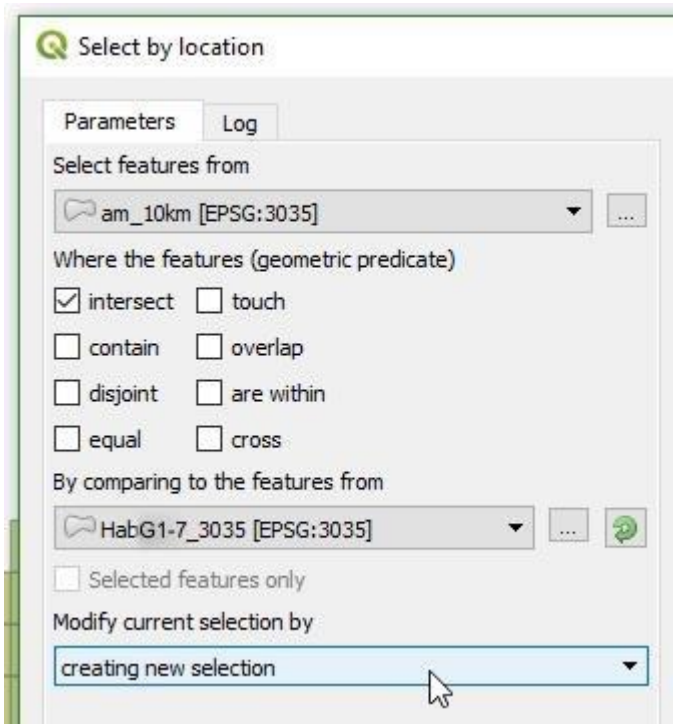
For some data types there are multiple ways of linking the data to the grid. For these the workflows are described separately with associated disadvantages and advantages.

2.4.1 Polygon distribution information

Basic spatial intersect method between distribution data and grid

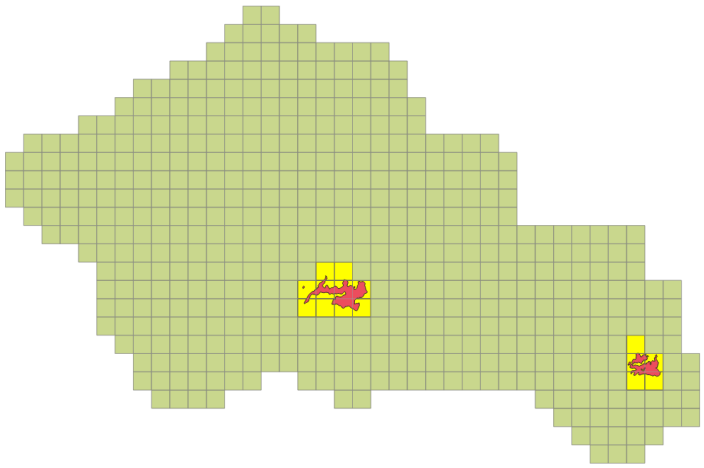
QGIS (basic spatial intersect method)	
Inputs:	Habitat distribution information: HabG1-7_3035.shp assuming state reserves represent habitat distribution (see above) Country grid excerpt: am_10km.shp[6] → both in CRS epsg:3035 
1	Open 'Select by location' 
2	Create a new selection by querying all grid cells which intersect with the habitat distribution data (here state reserves)

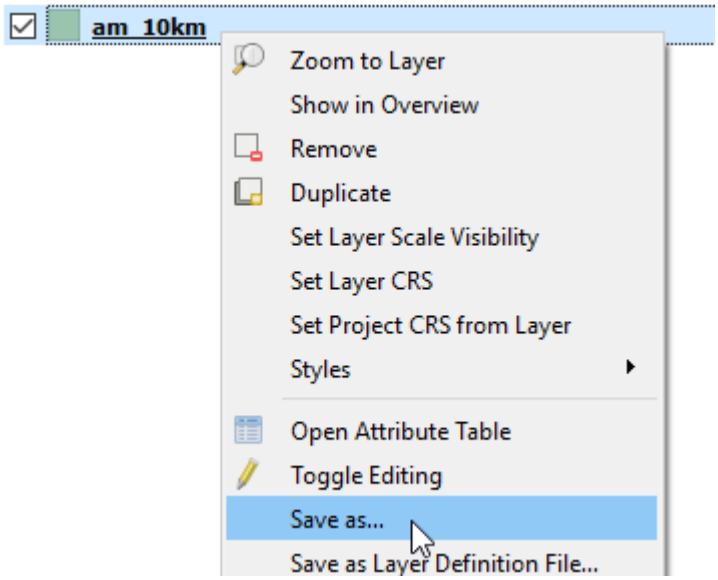
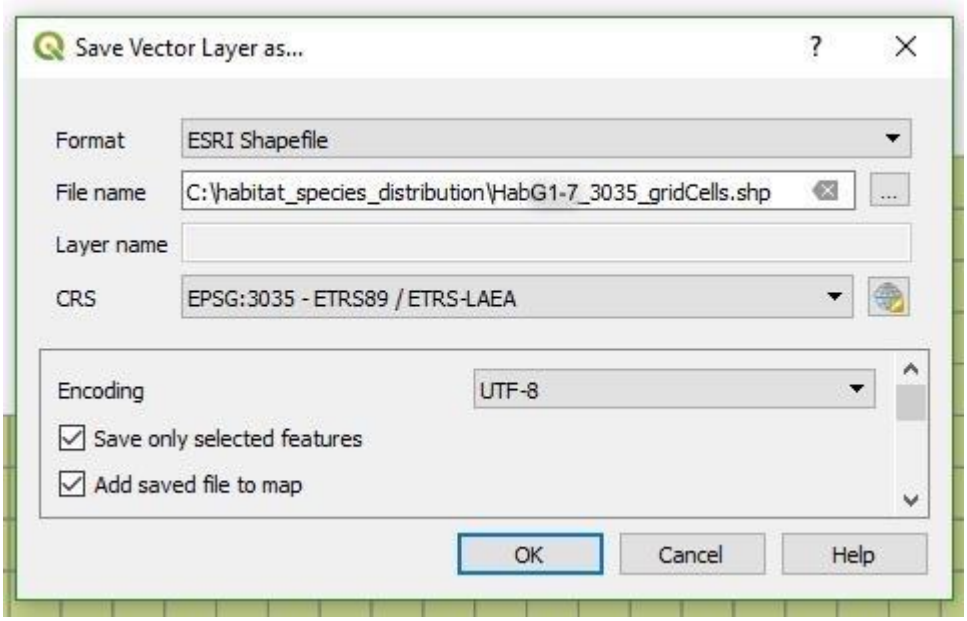
[6] https://eni-seis.eionet.europa.eu/east/areas-of-work/communication/events/project-related-events/biodiversity-training-on-reporting-to-the-emerald-network/reporting-workshop-documents/reference-10-x-10-km-grid-for-the-reporting

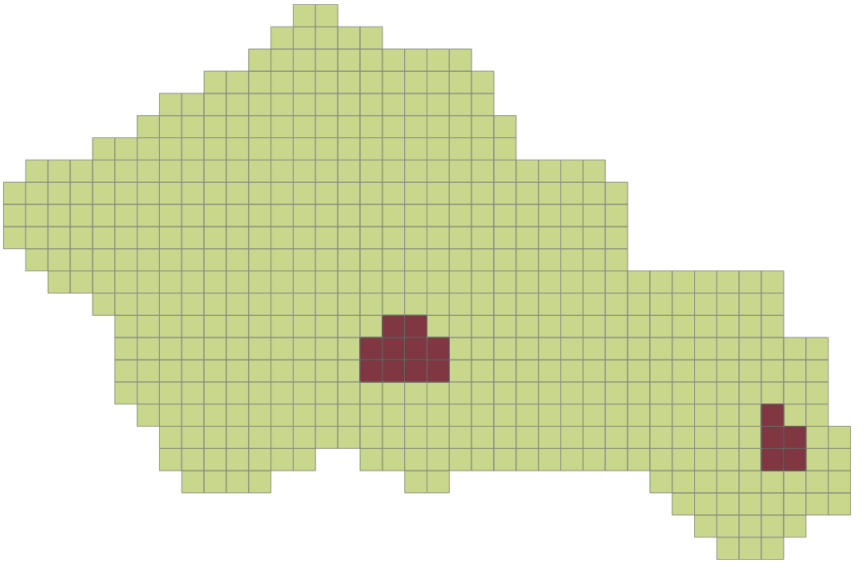
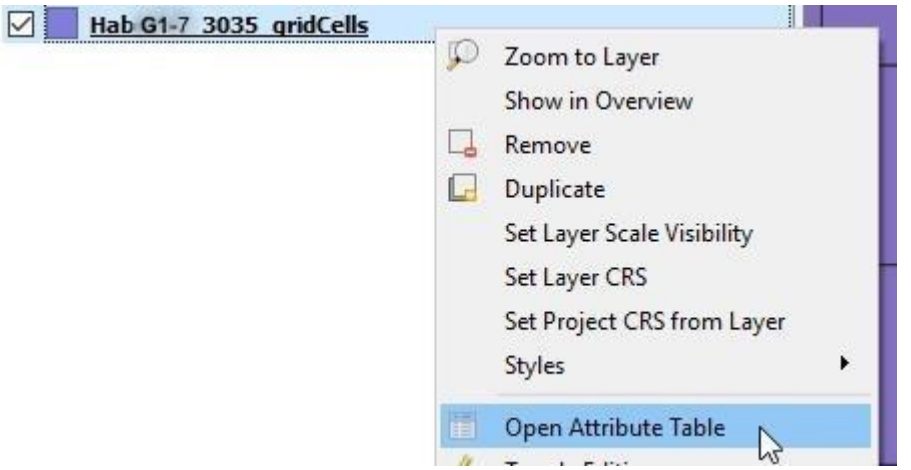


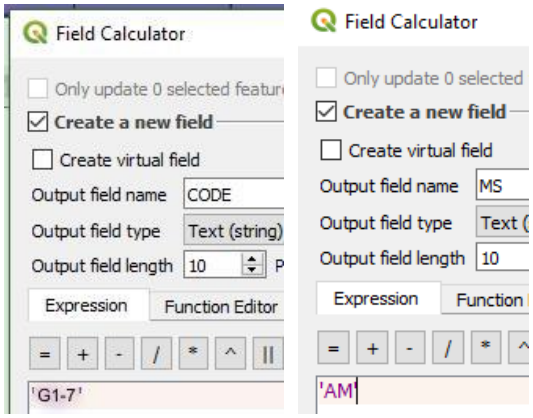
→ Run select by location

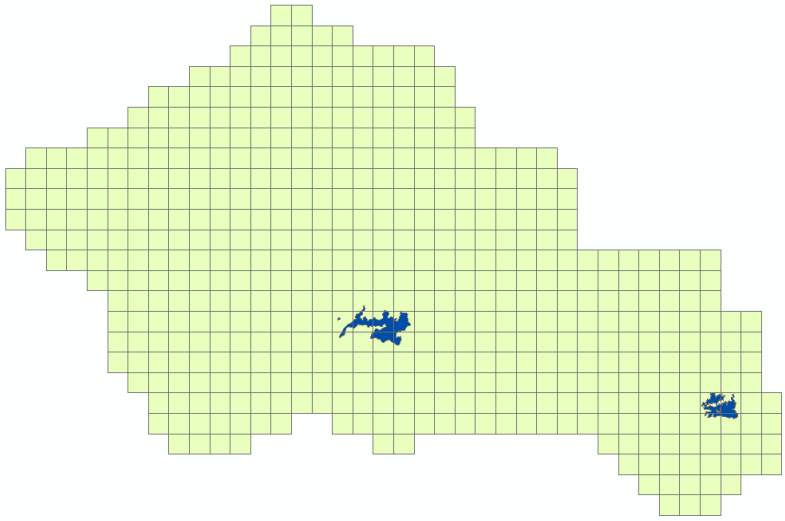
3 Intersecting grid cells will be selected and highlighted



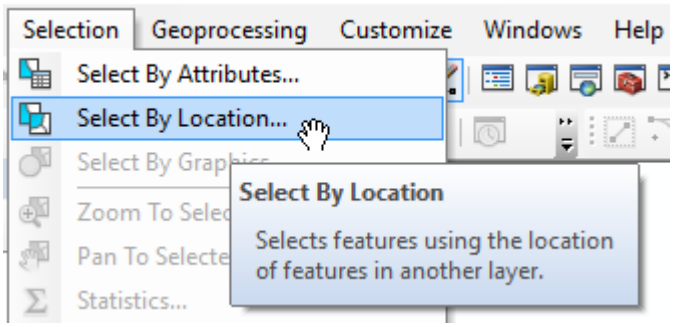
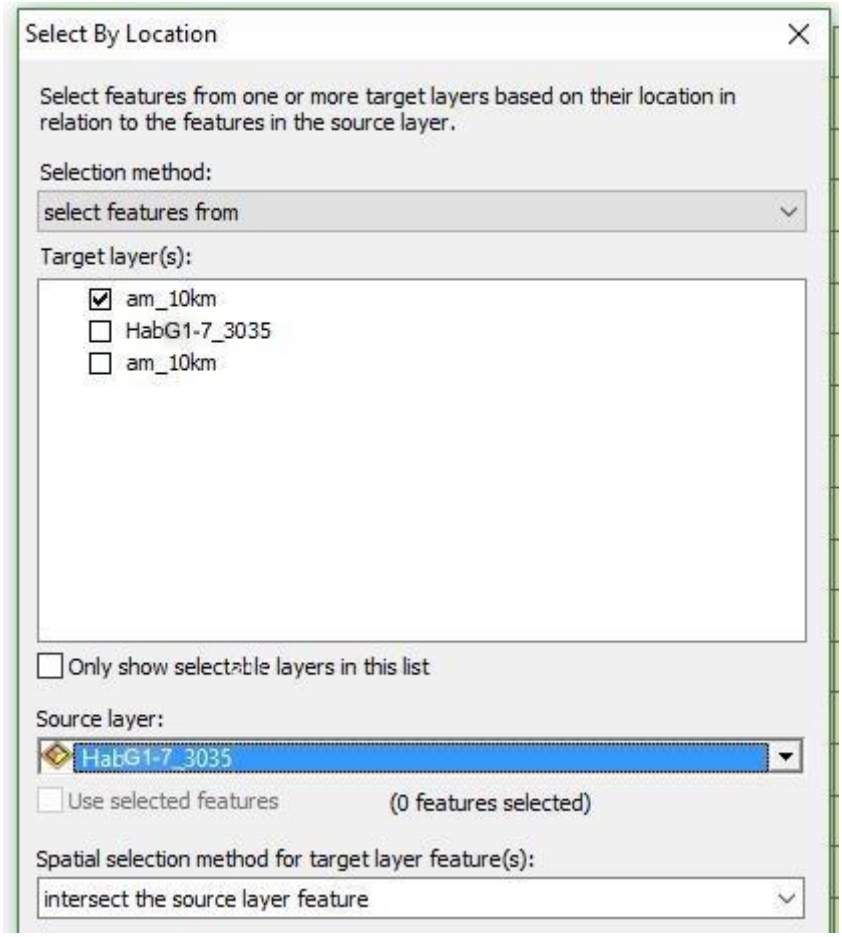
4	Right-click on the country grid (am_10km) and select 'Save as' 
5	Define an output for the habitat distribution grids for the specific habitat type and select 'Save only selected features' 
6	Dedicated grid shapefile only containing those grid cells which are intersecting with the habitat distribution in this case is produced.

	
7	Open Attribute table 
8	Add new fields in attributes and fill 'CODE', 'Region', 'XX' (country ISO2) and 'XX_CS' (conservation status by member state assessment for the specific occurrence) 

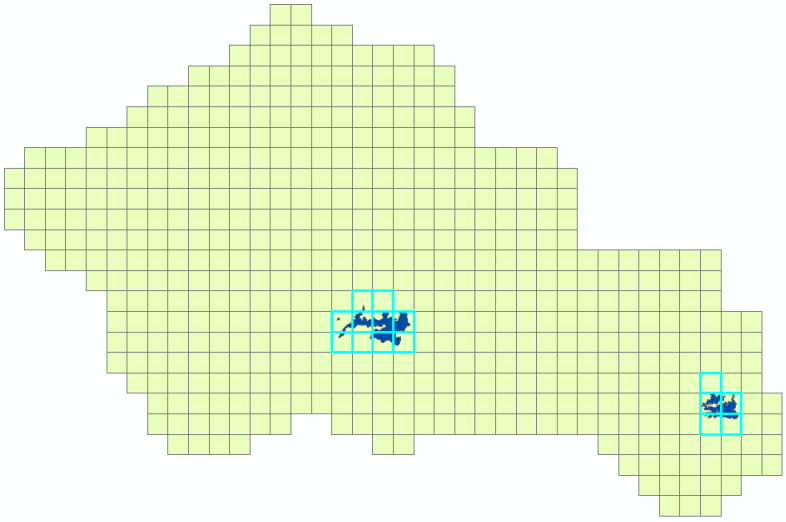
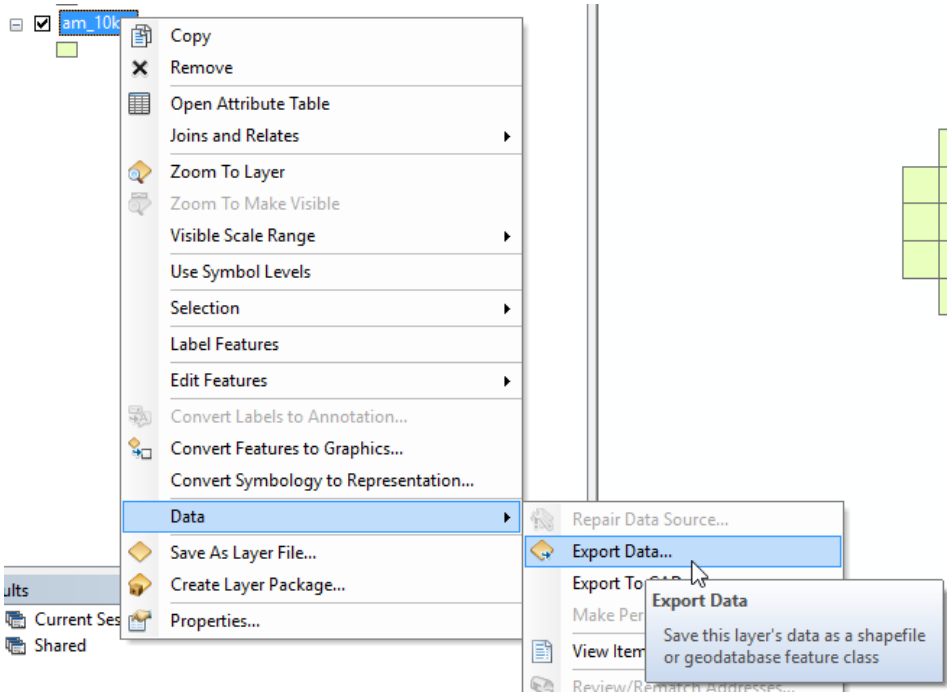
	 Fill other fields by hand according to national assessment and definitions of regions
9	Save edits 

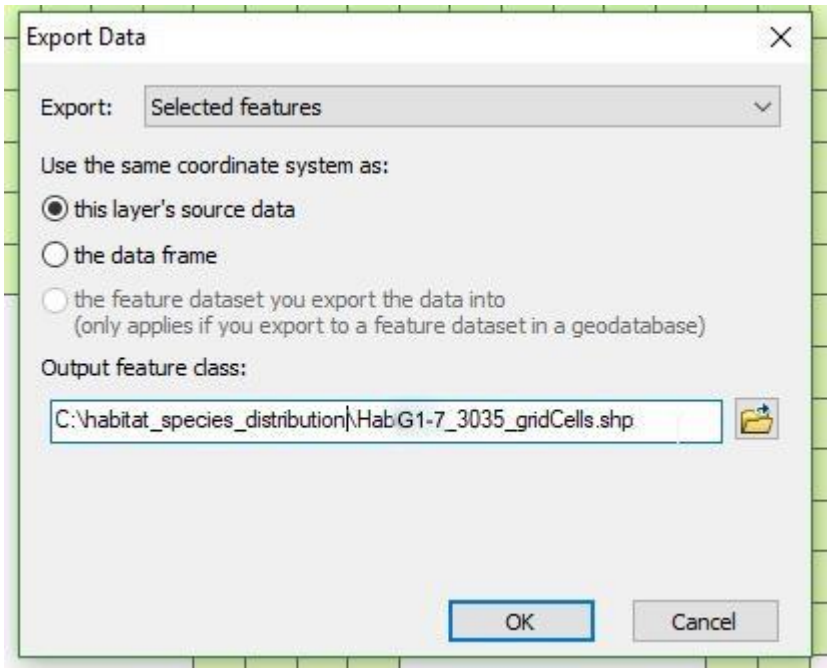
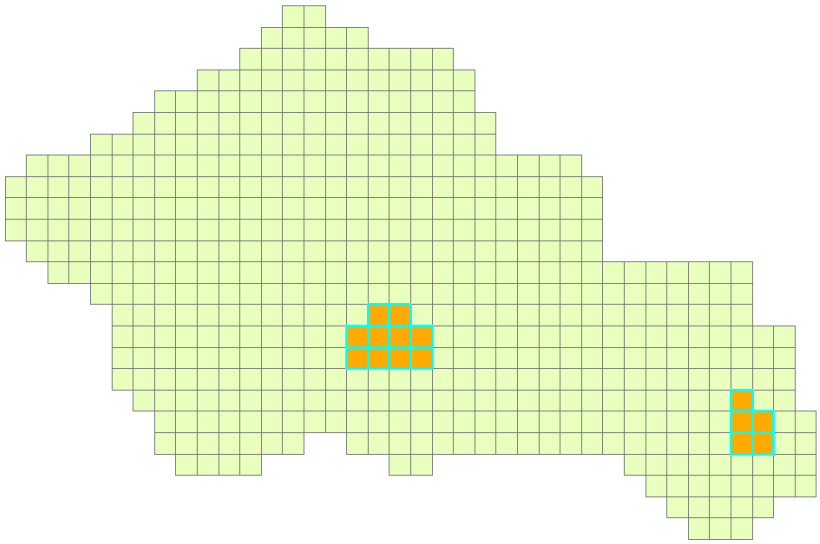
ArcGIS (basic spatial intersect method)	
Inputs:	Habitat distribution information: HabG1-7_3035.shp assuming state reserves represent habitat distribution (see above) Country grid excerpt: am_10km.shp[7] → both in CRS epsg:3035 
1	Open 'Select by location'

[7] https://eni-seis.eionet.europa.eu/east/areas-of-work/communication/events/project-related-events/biodiversity-training-on-reporting-to-the-emerald-network/reporting-workshop-documents/reference-10-x-10-km-grid-for-the-reporting

<table>
<tr><td></td><td> 
</td></tr>
<tr><td>2</td><td>Create a new selection by querying all grid cells which intersect with the habitat distribution data (here state reserves)
 

→ Run select by location with ‘OK’</td></tr>
</table>

3	Intersecting grid cells will be selected and highlighted 
4	Right-click on the country grid (am_10km) and select 'Data' → 'Export Data…' 
5	Define an output for the habitat distribution grids for the specific habitat type and select 'Export: Selected features'

	
6	Dedicated grid shapefile only containing those grid cells which are intersecting with the habitat distribution in this case is produced. 
7	Add additional fields CODE, Region, country and XX_MS

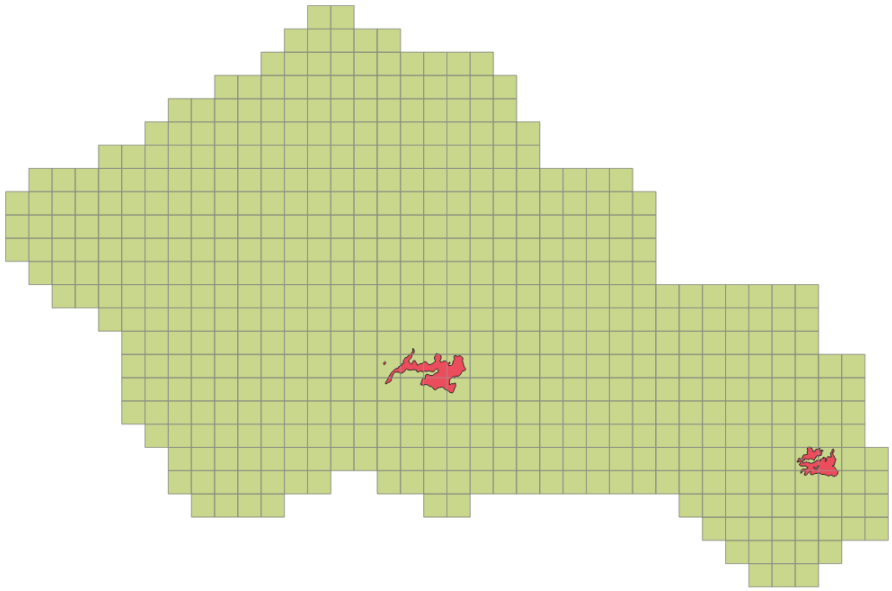
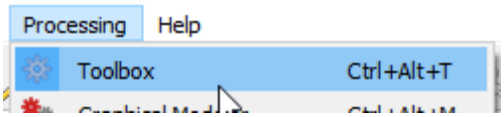
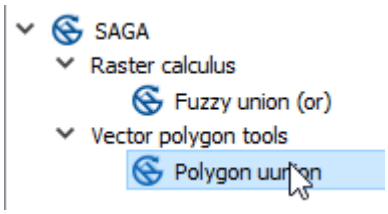
This method of selecting intersecting grid cells represents a basic and easy way to carry out the generation of a grid containing only cells where the habitat or species distribution is actually found.

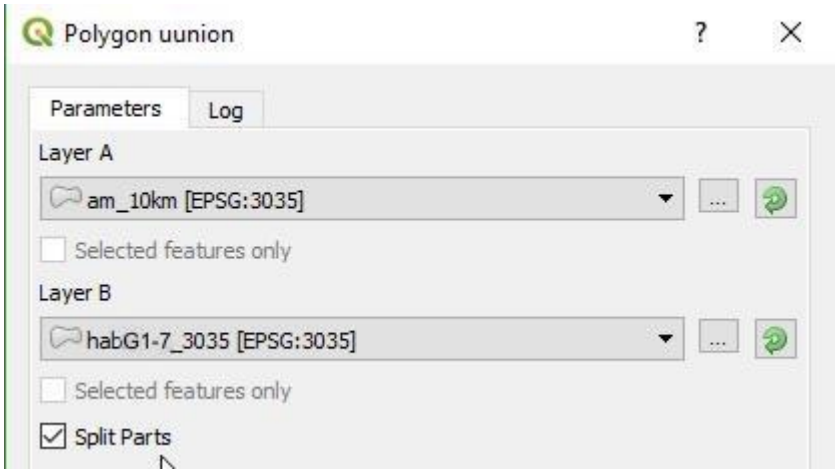
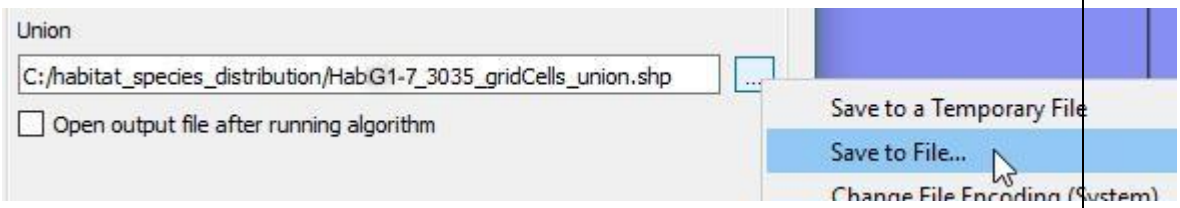
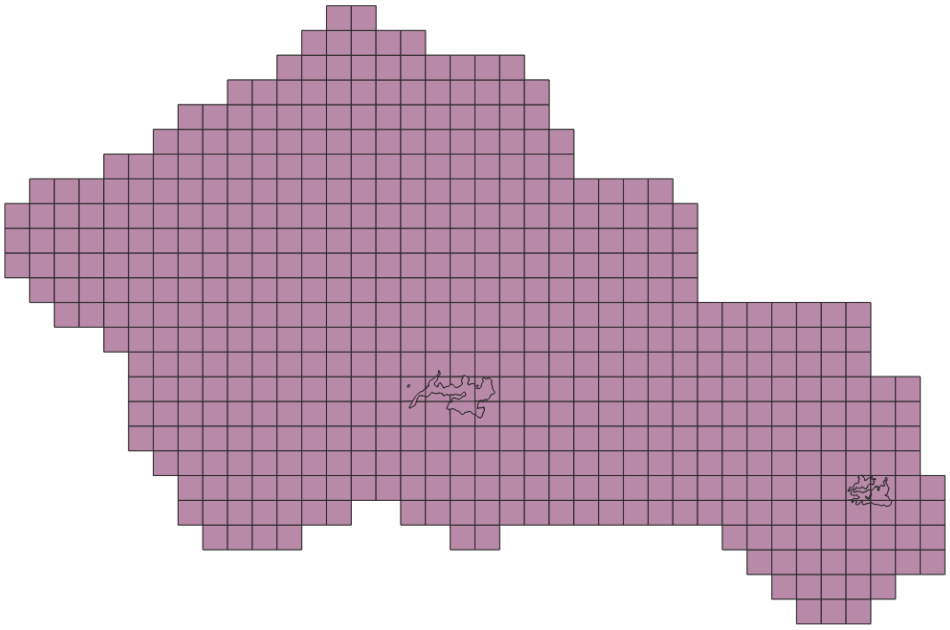
The major disadvantage is that all cells which are intersecting for only very small areas will be included in the distribution raster. There are no thresholds in this method to filter cells that only intersect for negligible levels of overlapping data.

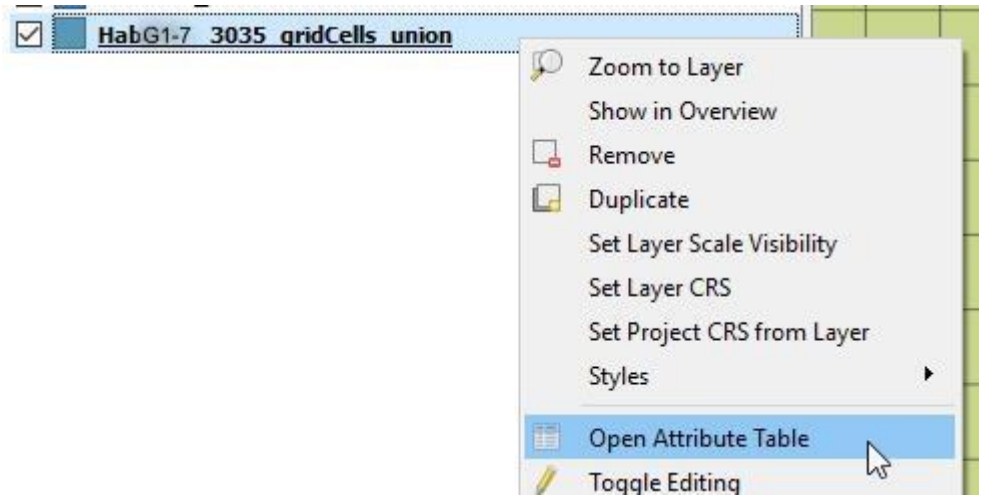
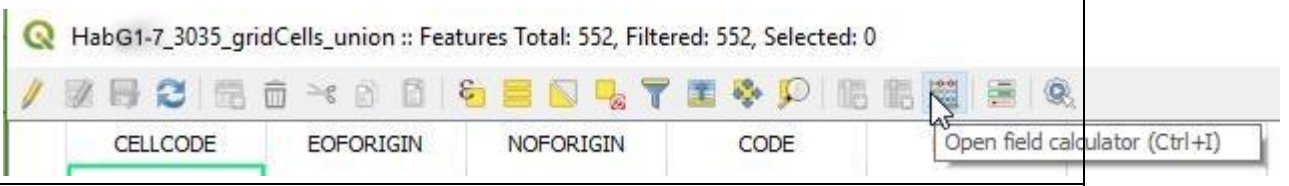
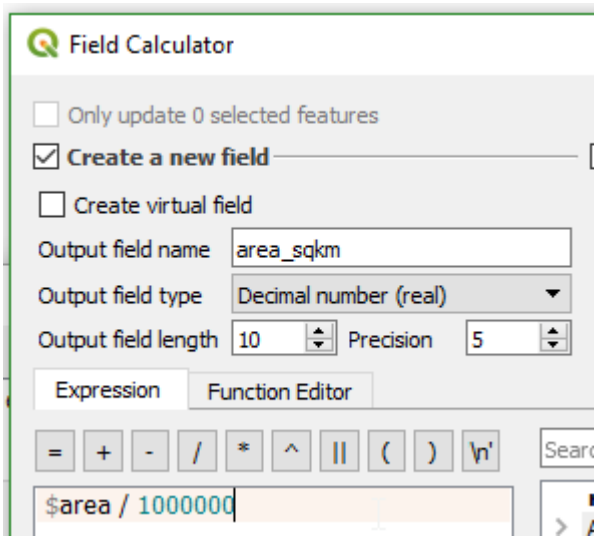
To introduce a minimum area or percentage of area filter the method shown next has to be applied.

Advanced spatial union method between distribution data and grid

The methodology shown here is just one way of creating the habitat/species specific distribution dataset incorporating thresholds. There are other ways which will also result in a separate dataset with the grid cells only where the distribution actually appears to the required extent. For the sake of convenience only one method is shown here.

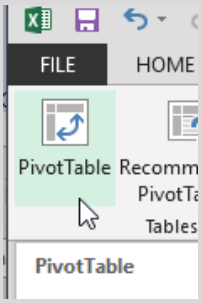
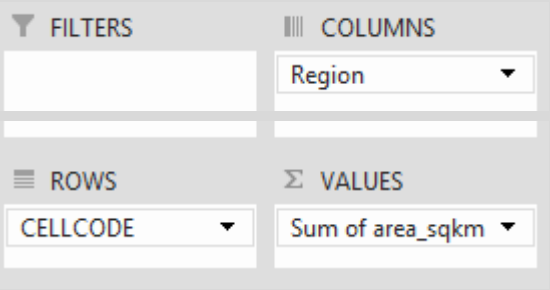
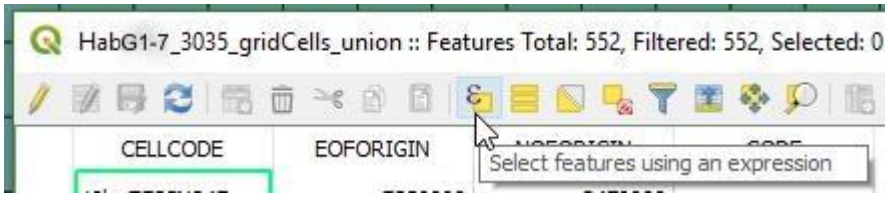
QGIS (spatial union method)	
Inputs:	Habitat distribution information: HabG1-7_3035.shp assuming state reserves represent habitat distribution (see above) Country grid excerpt: am_10km.shp → both in CRS epsg:3035 
1	Open ‘Processing Toolbox’ and type ‘Union’ 
2	Select ‘SAGA’ → ‘Polygon union’ 
3	Select country grid as input layer A and reprojected distribution data as union layer B

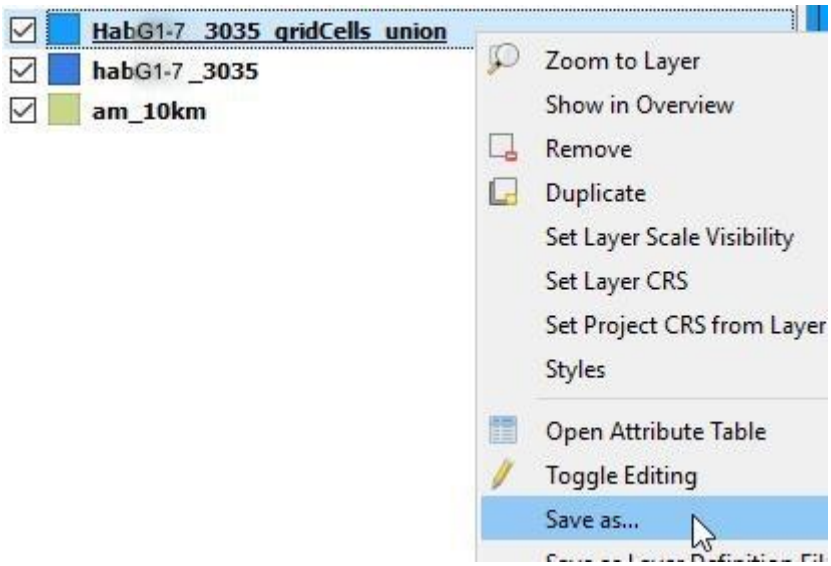
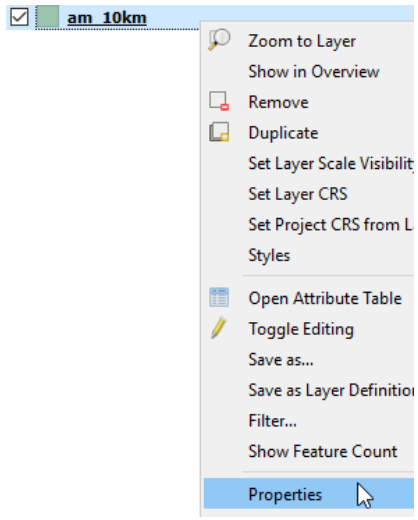
	
4	Define an output path for the union-dataset 
5	New dataset combining the distribution data as well as the grids is produced  → Load new produced shapefile
6	Calculate new field holding the area of each polygon → open attribute table

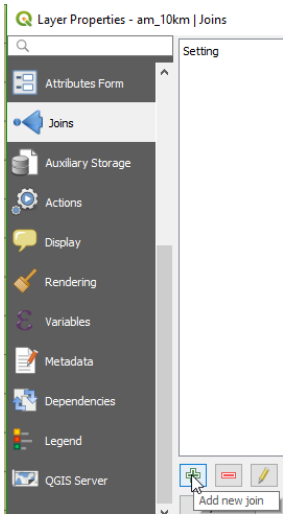
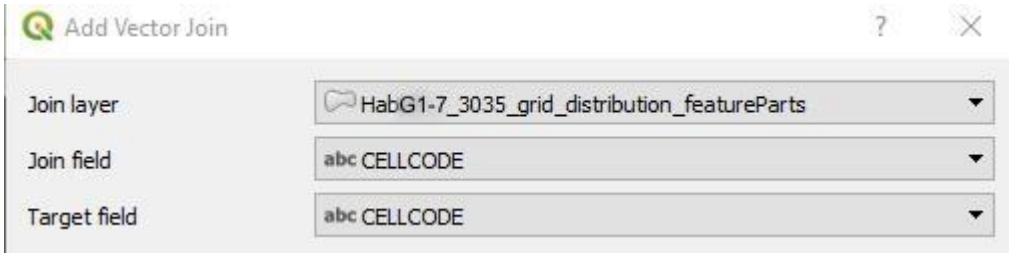
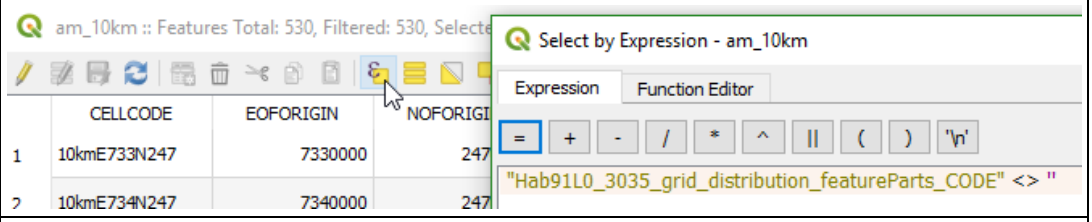
<table>
<tr><td></td><td> 
</td></tr>
<tr><td>7</td><td>Open field calculator
 
</td></tr>
<tr><td>8</td><td>Calculate new field area_sqkm (area in square kilometre km²)
 
</td></tr>
<tr><td>8a)</td><td>As multiple polygon features might occur in the same cell, external processing of the data is needed if more precise information is wanted.
By using the calculated area values, as they are produced until this step in the case of multiple elements in the same cell, only the area of one polygon feature will be joined to the grid in the next step.

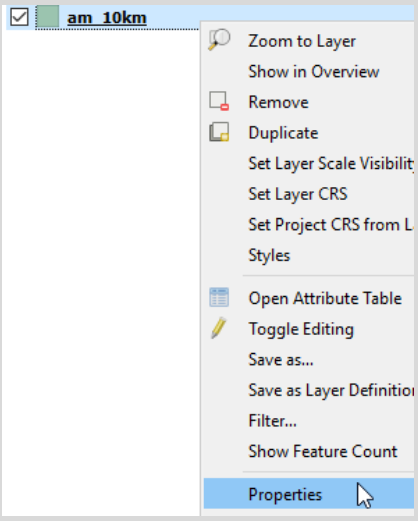
If this accuracy is acceptable proceed with step 4.

To further process the data and incorporate the area of all features within one cell continue with 3b) below.</td></tr>
<tr><td>8b)</td><td>To calculate the actual area of all features within one cell open the *.dbf file from the shapefile (in this example HabG1-7_3035_gridCells_union.dbf) in a calculation software such as Excel.</td></tr>
</table>

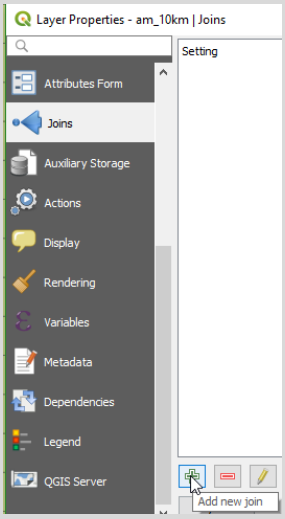
	→ Create pivot table from all columns  → select Cellcode as row and Region as column for pivot table (XX country as well as Code should not differ as these are fixed for the country respectively the input data which should only represent one type of species or habitat)  → filter only cells having value for 'Region' → deselect 'blanks' → save as Excel workbook (*.xlsx/*.xls) or other tabular data (please check if QGIS is able to read output format if different from *.xls) → HabG1-7_3035_gridCells_union_pivot.xlsx → load saved tabular data and continue at step 16
9	Select all grid cells where the habitat or species is present and the threshold chosen is fulfilled in attribute table   Explanation of selection expression:

	All polygons/features are selected which • have a habitat/distribution code → CODE <> (not equal) ‘’ (empty) • are bigger than the defined area threshold (here 30 is taken as it means feature must be bigger 30km² = 30% of 10x10km cell)
10	Export selected polygon into new file by right click on union dataset, setting output path (e.g. HabG1-7_3035_grid_distribution_featureParts.shp) and **selecting ‘Save only selected features’** 
11	Join exported features to raw grid cells again by opening properties of country grid 
12	Create a new join connection

	
13	Define join to exported selection of grid cell parts 
14	Select all grid cells where the joined field 'code' is not empty 
15	Save selected files to separate final shapefile containing only those cells where the distribution occurs → 'Save only selected features'
16	**CONTINUE ONLY IF HIGHER ACCURACY AS DESCRIBED UNDER 8b) IS USED!** Join HabG1-7_3035_gridCells_union to raw grid cells by opening properties of country grid

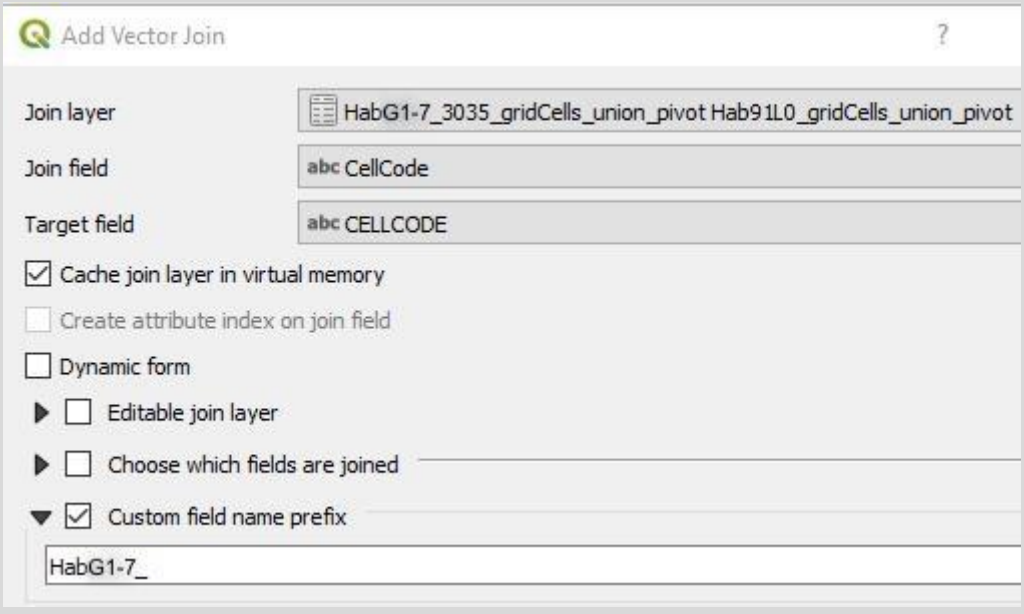


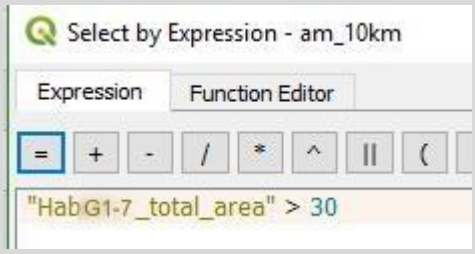
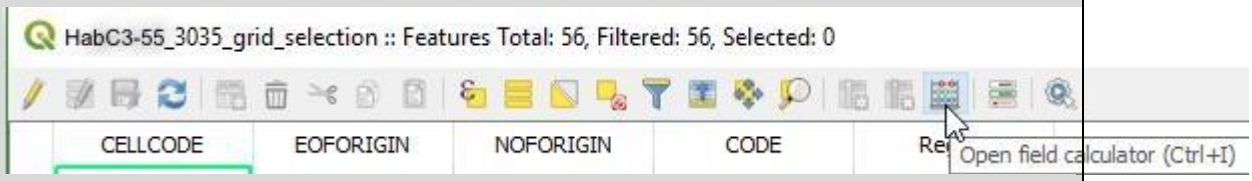
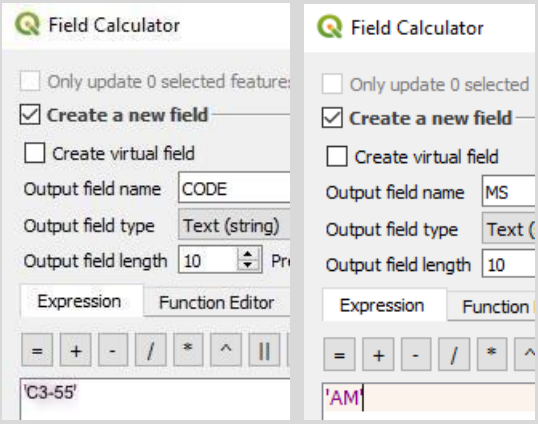
17 Create a new join connection



18 Define join to exported selection of grid cell parts

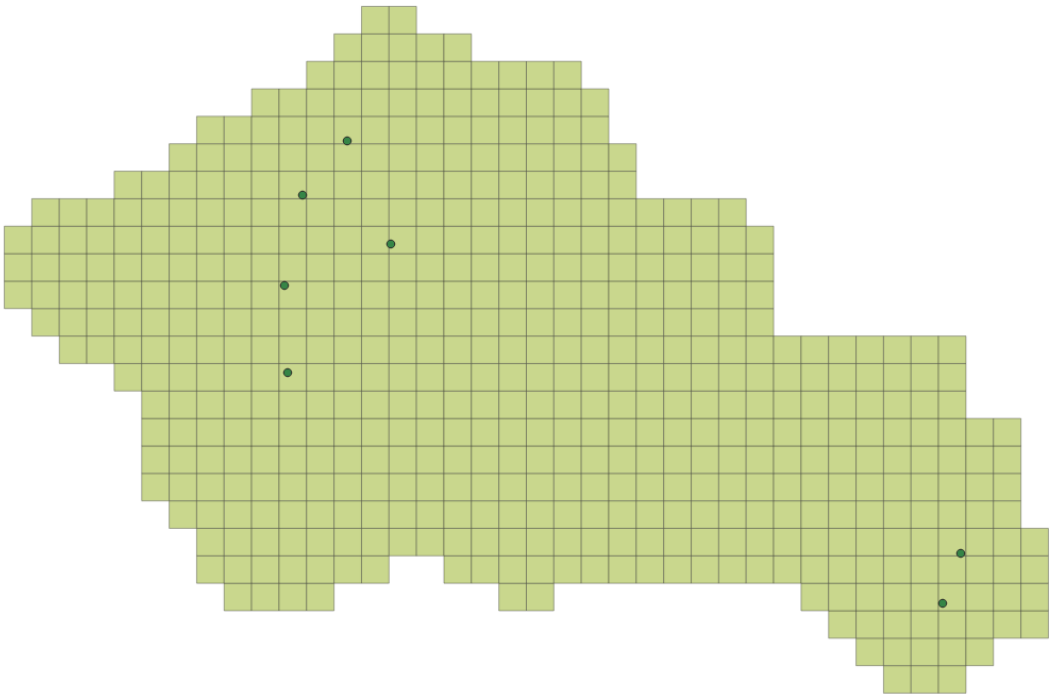
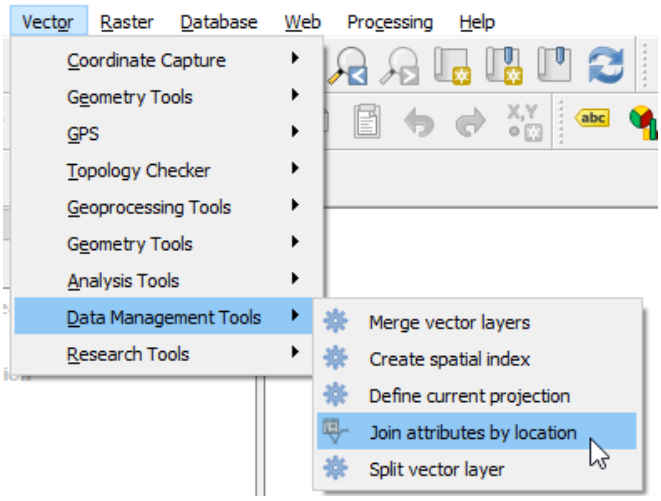
(Join layer name has been defined in Excel for specific sheet containing copy of pivot table and column names have been adapted there too)

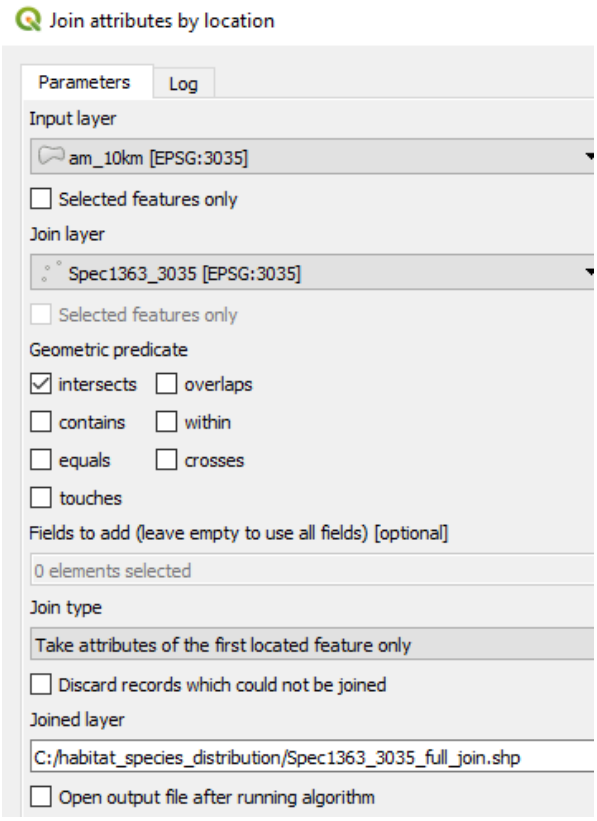


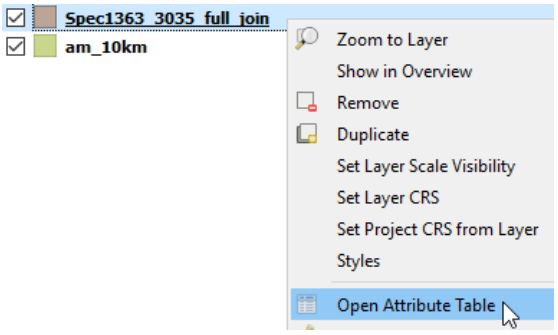
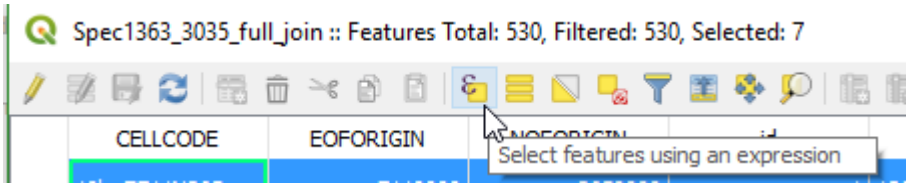
19	Select all grid cells where the joined field 'code' is not empty 
20	Save selected files to separate final shapefile containing only those cells where the distribution occurs → 'Save only selected features'
21	Adapt attributes if necessary: Add new fields in attributes and fill 'CODE', 'Region', 'XX' (country ISO2) and 'XX_CS' (conservation status by member state assessment for the specific occurrence)   Fill other fields by hand according to national assessment and definitions of regions

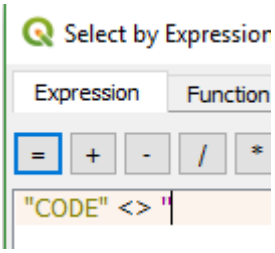
2.4.2 Point distribution information

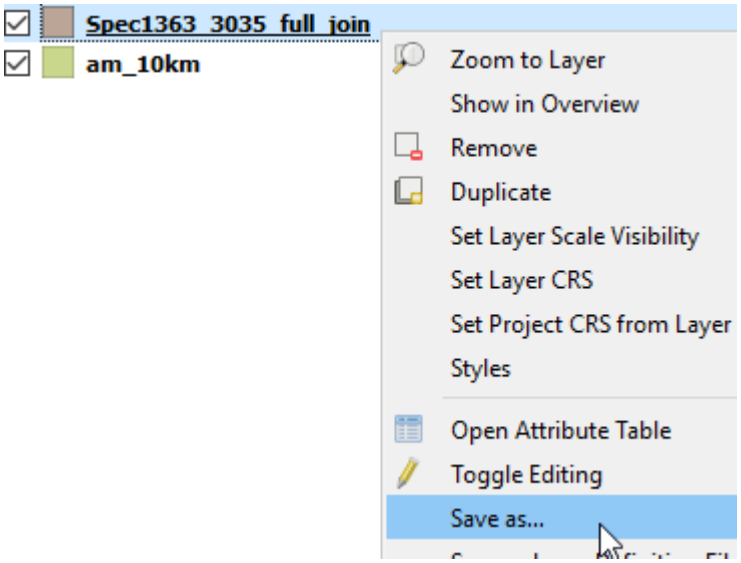
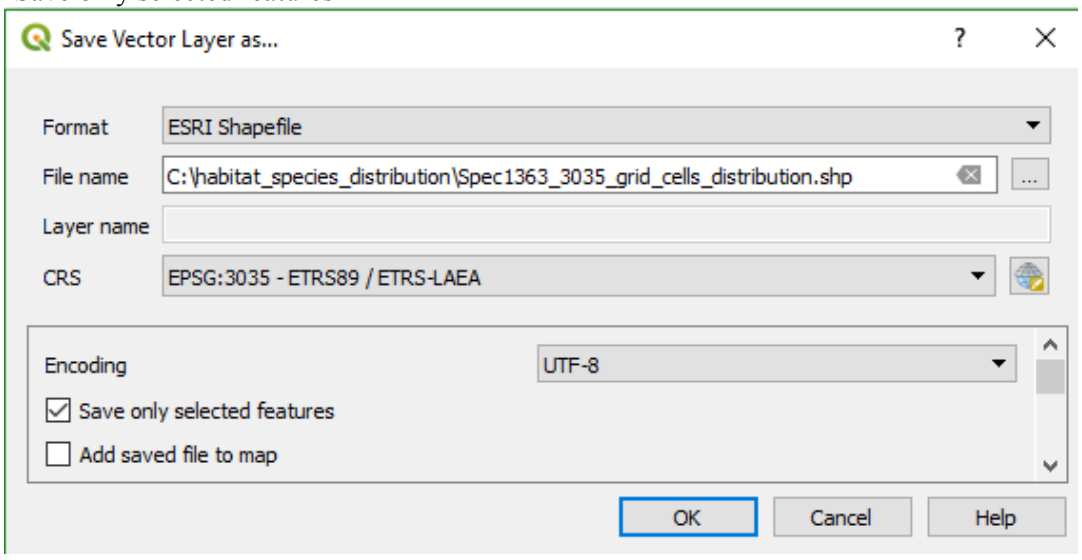
QGIS	
Inputs:	Habitat distribution information: Spec1363_3035.shp (sample dataset created artificially for theoretical distribution of felis silvestris; species code: 1363) Country grid excerpt: am_10km.shp → both in CRS epsg:3035

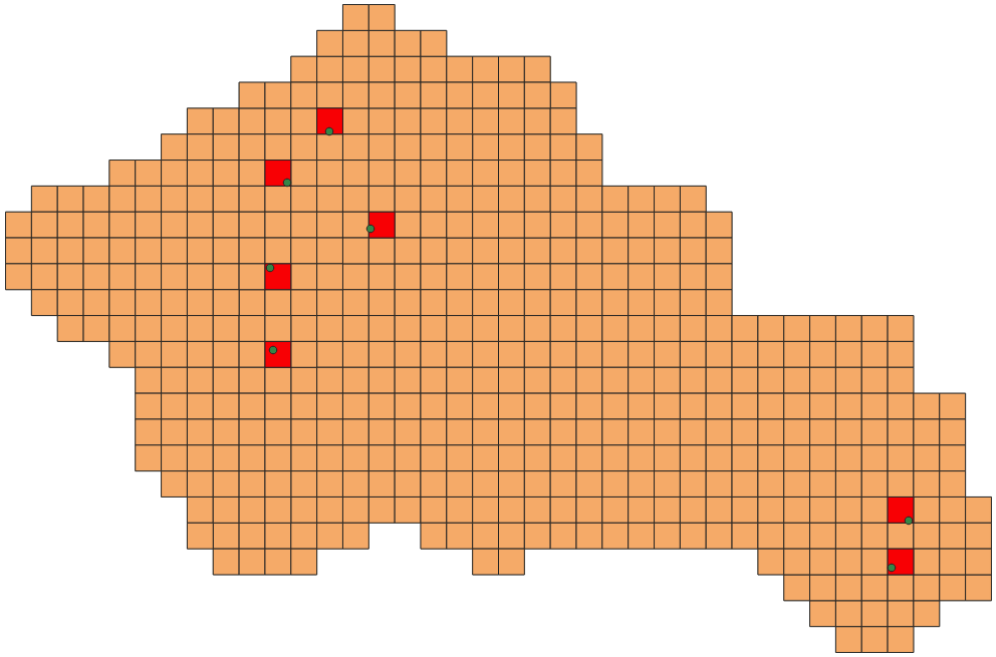
	
1	Open ‘Join Attributes by location’ 
2	Join point information to grid

<table>
<tr><td></td><td> 

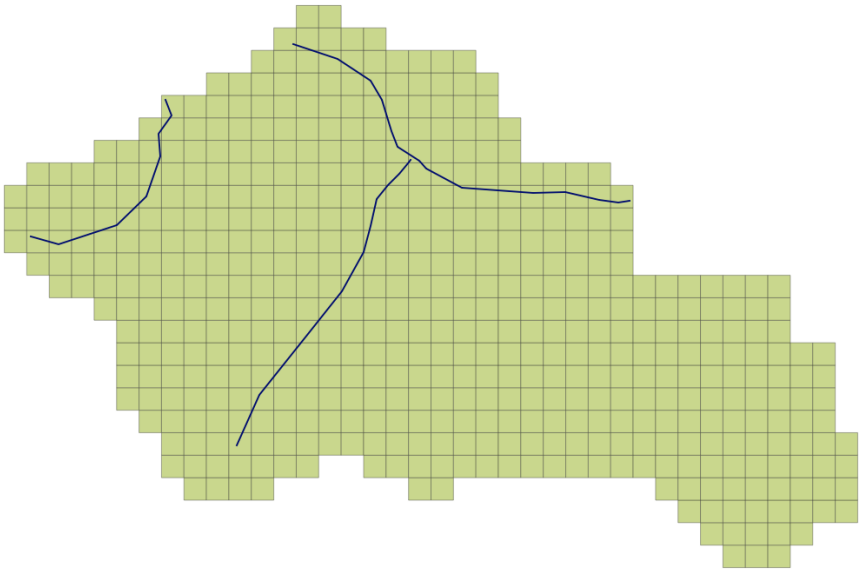
→ new shapefile ‘Spec1363_3035_full_join.shp’</td></tr>
<tr><td>3</td><td>Open new produced dataset and open Attribute Table

</td></tr>
<tr><td>4</td><td>Select all cells for which ‘CODE’ is not empty


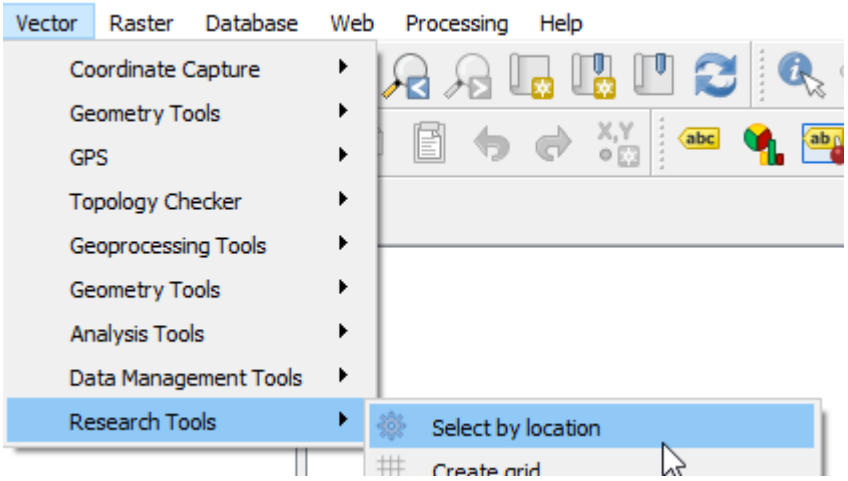
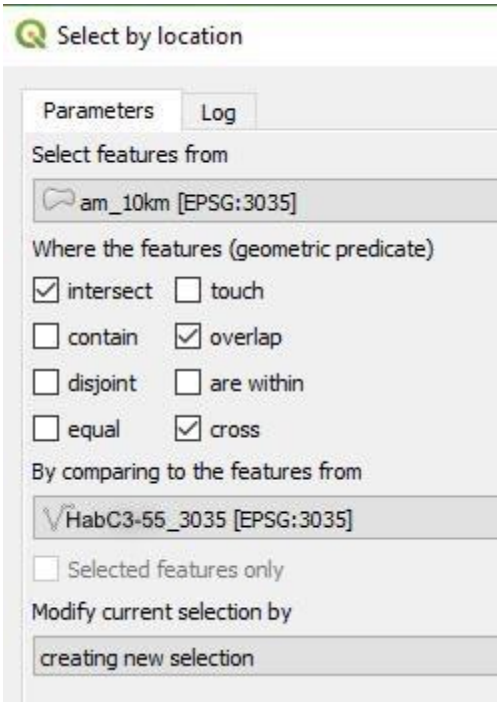

</td></tr>
</table>

5	Right-click on the joined country grid (Spec1363_3035_full_join.shp) and select 'Save as' 
6	Define an output for the habitat distribution grids for the specific habitat type and select 'Save only selected features' 
7	Dedicated grid shapefile only containing those grid cells which are intersecting with the species distribution in this case is produced.

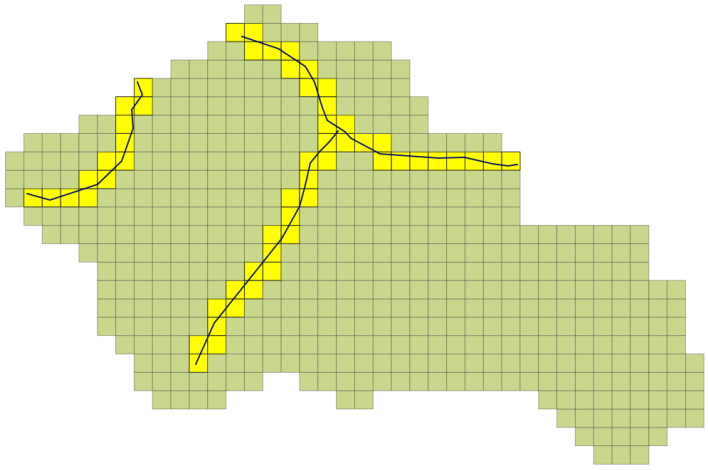
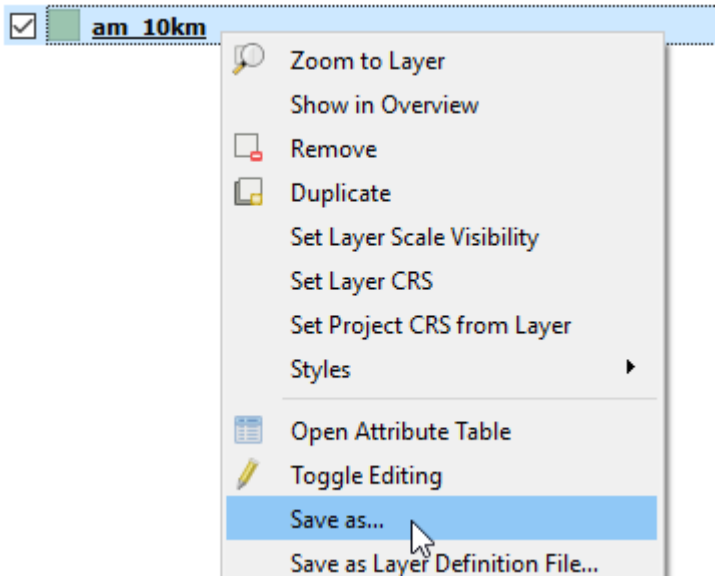
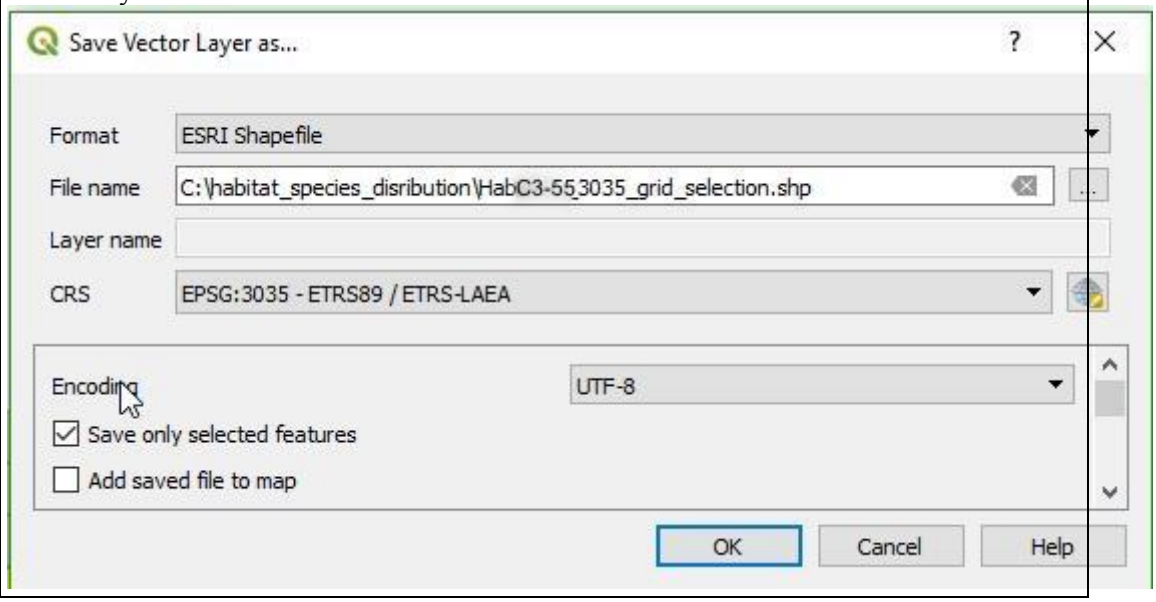


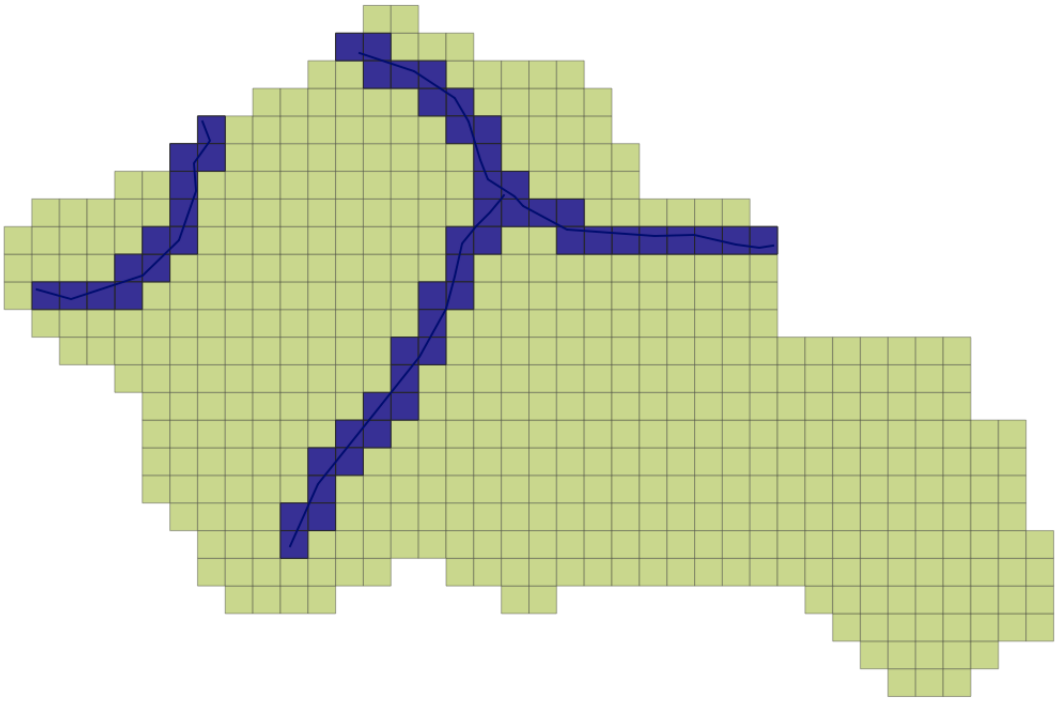
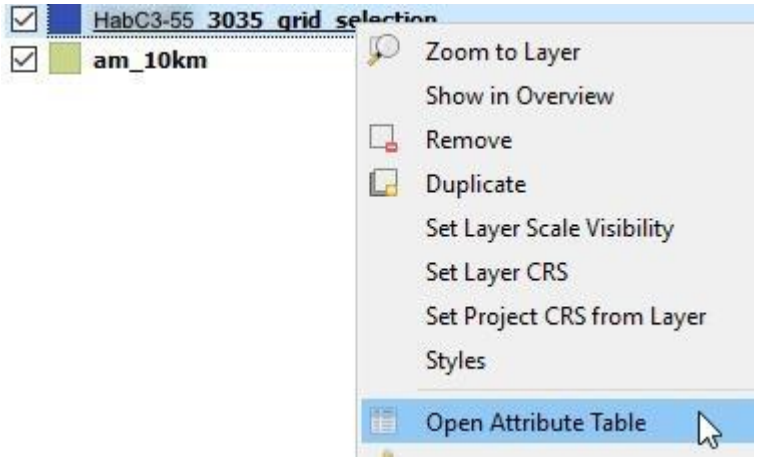
2.4.3 Linear distribution information

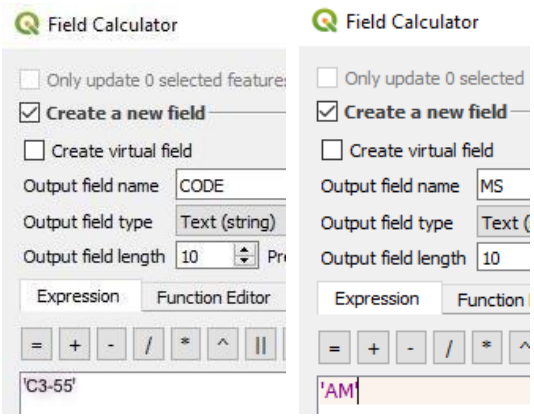
QGIS (basic spatial intersect method)	
Inputs:	Habitat distribution information: HabC3-55_3035.shp (sample dataset created artificially for theoretical distribution of 'Sparsely vegetated river gravel banks' habitat; habitat code: C3.55) Country grid excerpt: am_10km.shp → both in CRS epsg:3035 
1	Open 'Select by location'

<table>
<tr><td></td><td> 
</td></tr>
<tr><td>2</td><td>Create a new selection by querying all grid cells which intersect with the linear habitat or which are crossed by the habitat distribution.
 

→ Run select by location</td></tr>
</table>

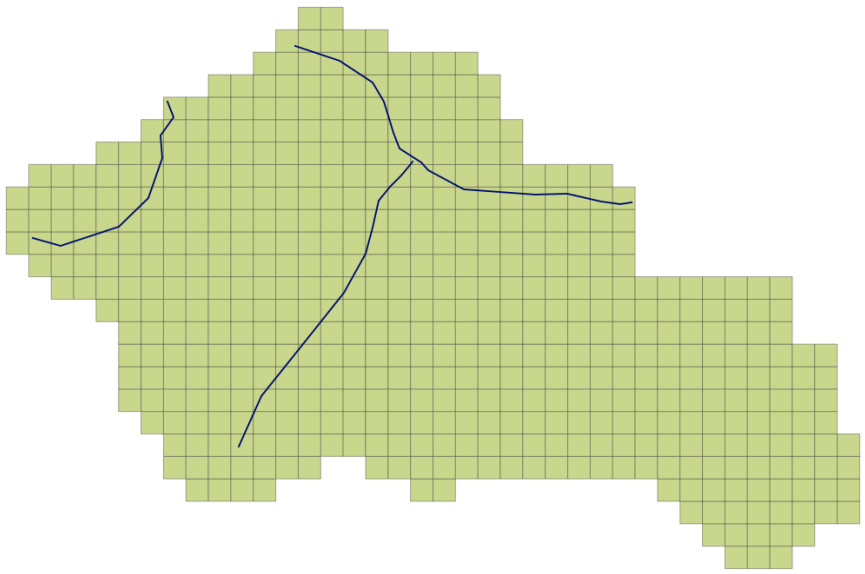
3	Intersecting grid cells will be selected and highlighted 
4	Right-click on the country grid (am_10km) and select 'Save as' 
5	Define an output for the habitat distribution grids for the specific habitat type and select 'Save only selected features' 

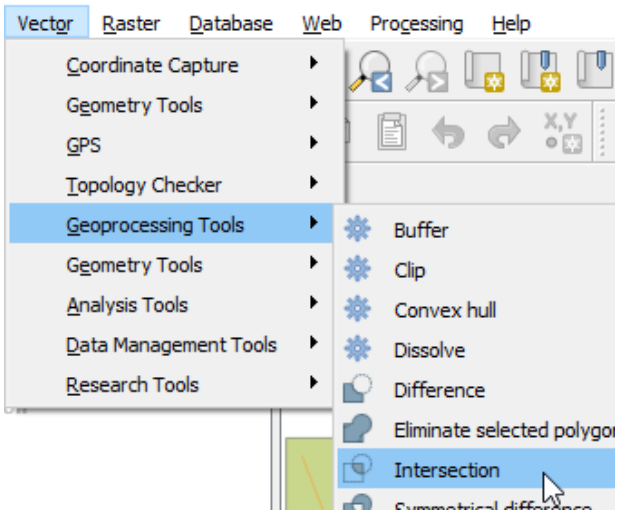
6	Dedicated grid shapefile only containing those grid cells which are intersecting with the habitat distribution is produced. 
7	Open Attribute table 
8	Add new fields in attributes and fill ‘CODE’, ‘Region’, ‘XX (country ISO2) and ‘XX_CS’ (conservation status by member state assessment for the specific occurrence) 

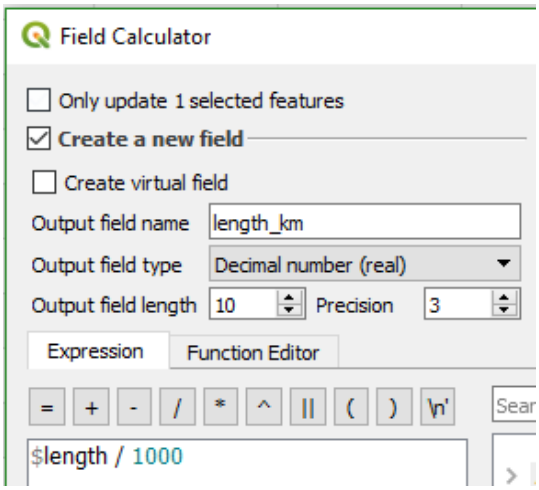
	 Fill other fields by hand according to national assessment and definitions of regions
9	Save edits 

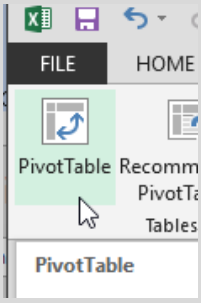
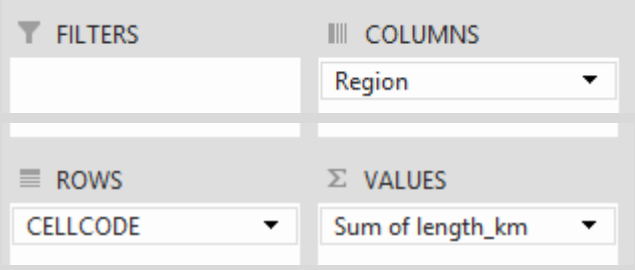
Advanced spatial union method between distribution data and grid

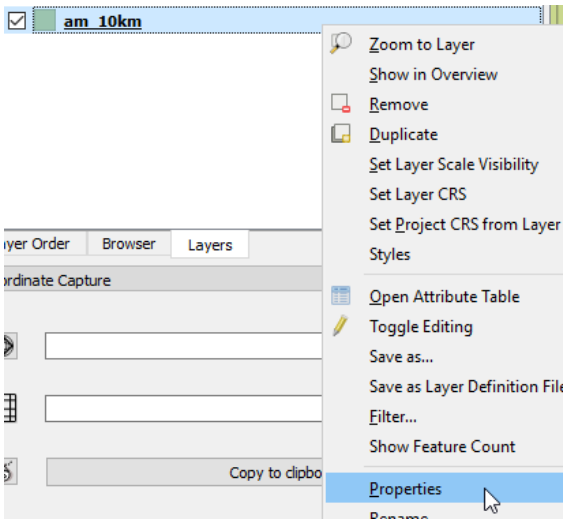
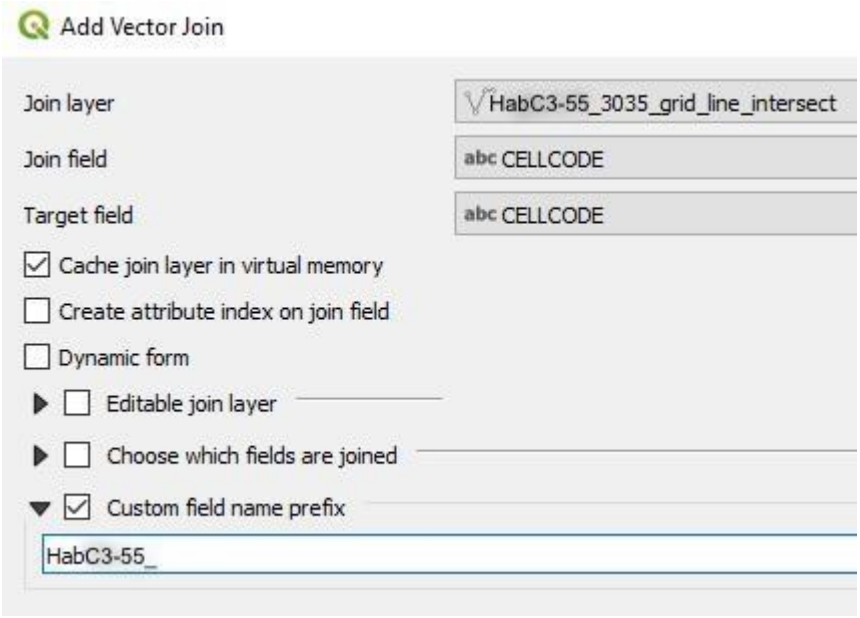
The methodology shown here is just one way of creating the habitat/species specific linear distribution dataset incorporating thresholds. There are other ways which will also result in a separate dataset containing the grid cells where only the distribution actually appears to the required extent. For the sake of convenience only one method is shown here.

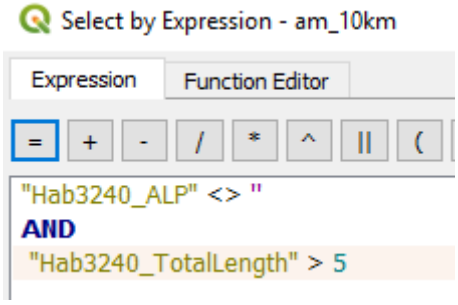
QGIS (spatial union method)	
Inputs:	Habitat distribution information: HabC3-55_3035.shp (sample dataset created artificially for theoretical distribution of 'Sparsely vegetated river gravel banks' habitat) Country grid excerpt: am_10km.shp → both in CRS epsg:3035 

1	Open ‘Intersection’ tool 
2	Set line input as first, grid as second input layer and define output path 
3	Add a new field ‘length_km’ and calculate length of linear segment

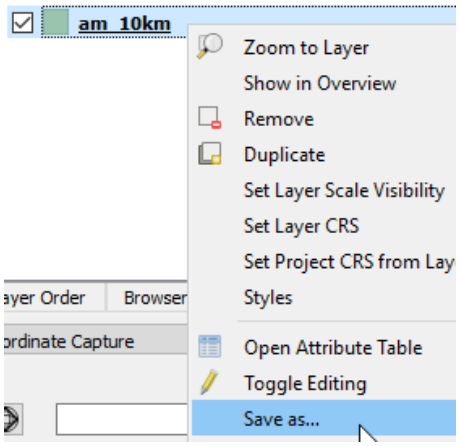


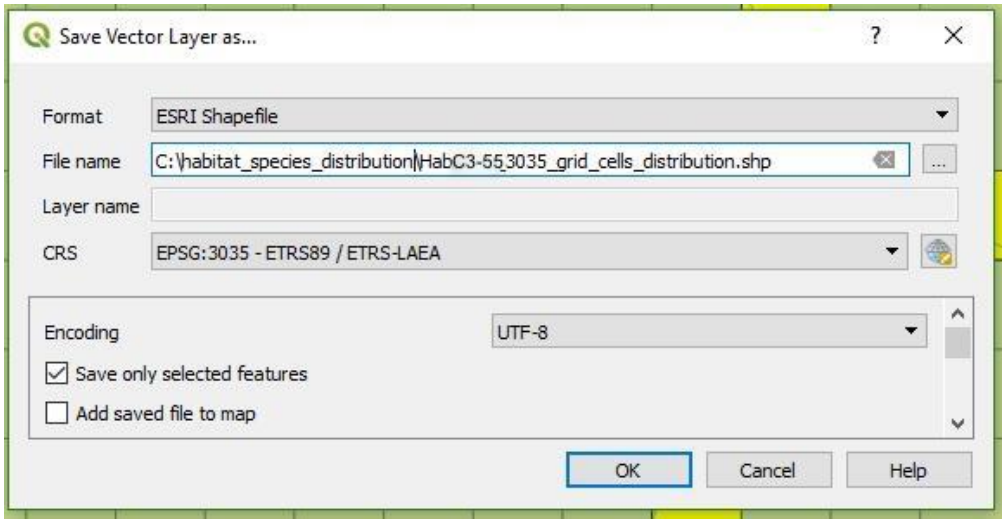
3a)	As multiple linear features might occur in the same cell external processing of the data is needed if more precise information is wanted to be used. By using the calculated length values as they are produced until this step in case of multiple linear elements in the same cell only the length of one line will be joined to the grid in the next step. If this accuracy is sufficient proceed with step 4. To further process the data and incorporate the length of all linear features within one cell continue with 3b) below.
3b)	To calculate the actual length of all linear features within one cell open the *.dbf file from the shapefile (in this example HabC3-55_3035_grid_line_intersect.dbf) in a calculation software such as Excel. → Create pivot table from all columns  → select Cellcode as row and Region as column for pivot table (XX country as well as Code should not differ as these are fixed for the country respectively the input data which should only represent one type of species or habitat)  → save as Excel workbook (*.xlsx/*.xls) or other tabular data (please check if QGIS is

	able to read output format if different from *.xls) → HabC3-55_3035_grid_line_intersect_pivot.xlsx → load saved tabular data and continue with this instead of 'linear feature' for steps below.
4	Join linear features to full grid → open properties of country grid 
5	Add new join linking the intersected lines (or preprocessed tabular data) to the grid cells through the Cellcode 
6	Select all grid cells for which linked information from the lines (linear habitat/species distribution occurring) is available and the defined minimum length for linear objects is fulfilled.



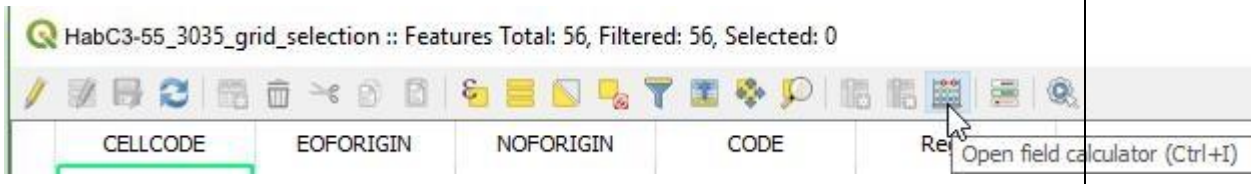
7 Save selected cells as dedicated shapefile

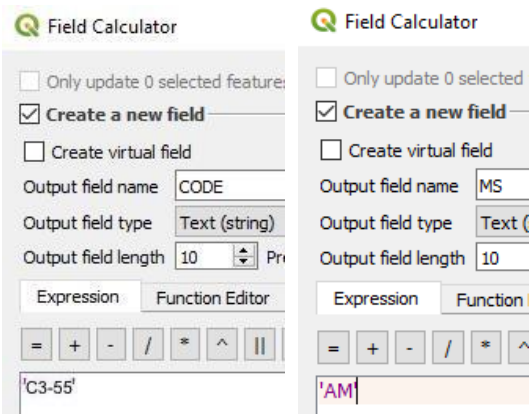




8 Adapt attributes if necessary:

Add new fields in attributes and fill ‘CODE’, ‘Region’, ‘XX’ (country ISO2) and ‘XX_CS’ (conservation status by member state assessment for the specific occurrence)





Fill other fields by hand according to national assessment and definitions of regions

2.4.4 Grid based distribution information

In cases where the national data on species or habitat distribution is represented by grid data where more complex preparation and data processing is required for the transfer of national grid data into the 10 x 10 km grid, as required for the reporting, please refer to the presentations held during the workshop or contact the EEA for further information:

- UK experience of converting mapping data from national grid to EU grid (JNCC)
- Guidance for converting the national distribution data to the Pan-European 10 x10 km Grid