European Environment Agency

Calculating the coverage of Corine land cover classes inside Natura 2000 sites aggregated by NUTS regions: The raster approach

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Contents

1 Introduction

This document explains the methodology behind the raster based statistics on the Corine land cover (CLC) in the Natura 2000 network aggregated by NUTS3 regions. The resulting statistic has three pivot tables, one for the CLC area in Natura 2000 sites designated under the Birds Directive (SPAs) only, one for the CLC area in Natura 2000 sites designated under the Habitats Directive (SCIs/SACs) only and one for the CLC area in the full Natura 2000 network, i.e. sites designated under both Directives.

2 Input datasets

The input datasets for the area calculation are the Natura2000 network, the Corine land cover and the NUTS regions. The first two datasets are publicly available from the EEA website while the NUTS regions are license restricted and only the metadata is publicly available.

The Natura 2000 network v2015 (.shp format)
http://www.eea.europa.eu/data-and-maps/data/natura-7#tab-gis-data.

Corine land cover version 2006 (CLCv2006) 100m raster, http://www.eea.europa.eu/data-and-maps/data/corine-land-cover-2006-raster-3, was gapfilled with Corine land cover version 2000 (CLCv2000) 100m raster, http://www.eea.europa.eu/data-and-maps/data/corine-land-cover-2000-raster-3, as Greece and Azores was not included in the CLC2006 version at the time.

The resulting dataset is internally available at EEA, the metadata can be accessed from http://sdi.eea.europa.eu/catalogue/srv/eng/catalog.search;jsessionid=2A4B78F79FDCD45C27521CD4C223C2F3#/metadata/2d6f67b9-c912-4ba5-94ee-1af821a24729 .

Administrative units from Euroboundary map (EBMv5) 100m. The metadata is available from http://sdi.eea.europa.eu/catalogue/srv/eng/catalog.search;jsessionid=2A4B78F79FDCD45C27521CD4C223C2F3#/metadata/a6a9ee28-028e-4782-a3b1-369b1dbc5d9b.

The coordinate reference systems of the three datasets are EPSG:3035 which is best suited for area calculations as it has an equal area projection.

3 Methodology of surface area calculation

The area calculations are based on raster analysis carried out in ArcGIS 10.2, the processing steps are managed using the ArcGIS Model builder.

The Corine land cover (CLC) data is in 100m raster format when downloaded from the EEA website. Also the NUTS layer is available in 100m raster format. The Natura 2000 network data comes in a vector format (shape file) and requires rasterization by site designation type. Three raster layers are needed before calculating the statistics. One layer with Bird Directive areas: SPA sites = A types; one with Habitat Directive areas: SCI/SAC sites = B types; and one with the sites that are designated as both SPA and SCI/SAC = C types. This means that 1) all Bird Directive sites are calculated by combining the A + C types, 2) all Habitat Directive sites are calculated by combining the B + C types and 3) the full Natura 2000 network is calculated by combining all types (A + B + C).

There are six processing steps:

- Step 1: Iteration by Member State, selection of site type, dissolving by site type and rasterisation in a 100 meter resolution.
- Step 2: Reclassification of the attribute values of all input data.
- Step 3: Intersection of the NUTS3 regions, the CLC and each of the Natura 2000 layers with multiplication of attributes values.
- Step 4: Disaggregation of the value by Nuts3 region (5 digits), Natura2000 (100 or 0 value) and CLC (45 classes) and respective joins to recover their alphanumeric attribute values.
- Step 5: Area calculation in km2
- Step 6: Merge of tables of by the respective site type, NUTS3 code and CLC class by Member State and export to Excel.

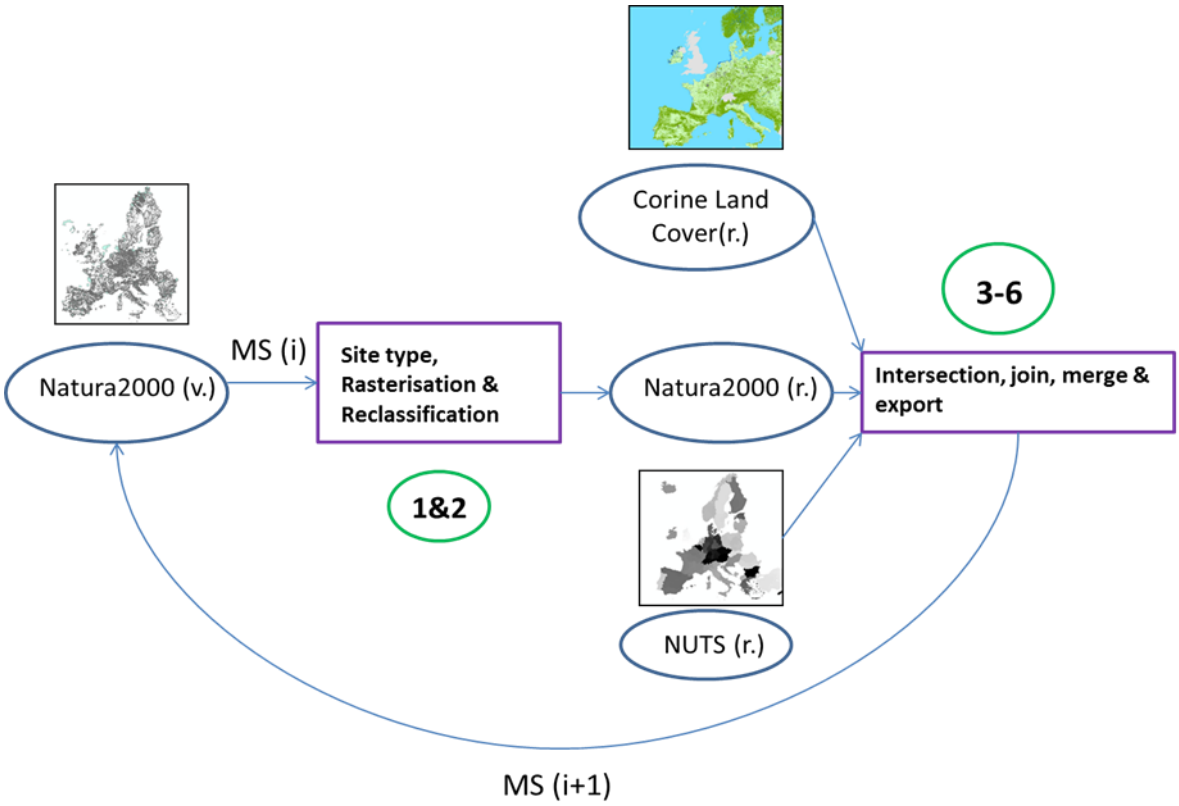

Figure 1 - Processing steps for the raster approach

Step 1: Iteration by member state, selection of site type, dissolve of Natura2000 dataset and rasterisation.

The extraction of the spatial data is done through selection criteria based on an iteration of Member State and querying the site type. In the tabular database, Member States deliver the site type category for each unique Natura2000 site code.

First, the spatial data are filtered out from the European database by using the A + C types (SPA sites), the B + C types (SCI/SAC sites) and the A + B + C types (all sites).

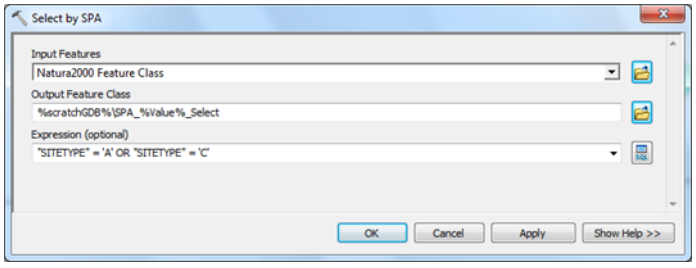

Figure 2 - Selection by site type (SPA)

After the finalisation of step 1, three datasets are available for the further calculations: the Birds sites dataset (SPA sites), the Habitats sites dataset (SCI/SAC sites) and the complete Natura 2000 network dataset (all Natura 2000 sites).

The categorisation of the Natura 2000 sites stands as follows:

- SPA: Site type A + C
- SCI/SAC = "SCI" below: Site type B + C
- All Natura 2000 = "NAT" below: Site type A + B + C

After the selection, the overlapping areas of the selection were removed by dissolving areas and then a 100 meter resolution raster was created from each of the three datasets.

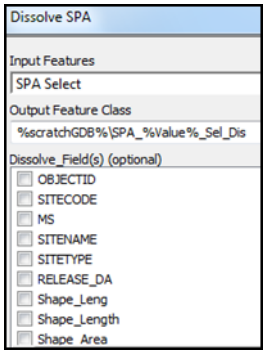

Figure 3 - Dissolve (SPA)

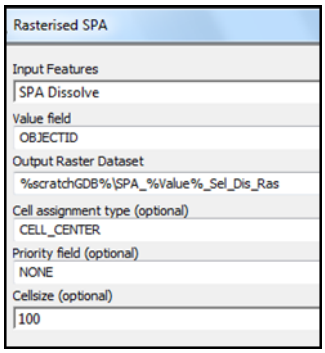

Figure 4 - Rasterisation (SPA)

Step 2: Reclassification of site by Member State

Before the intersection between Natura 2000, CLC and NUTS rasters, a reclassification of the results of the previous step was made. As the rasterisation of Natura 2000 was made by the OBJECTID and there could be thousands of rows, all values were classified to the value 100. The pixels with no values were classified to 0.

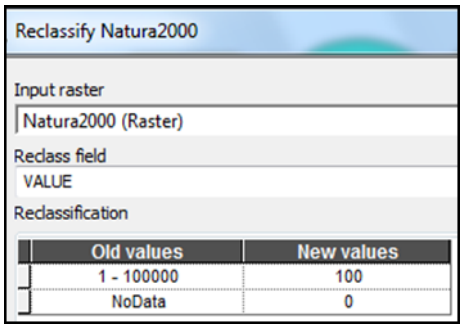

Figure 5 - Reclassification (Natura2000)

Also the CLC and the NUTS rasters had to undergo a reclassification of the raster pixel values in order to distinguish the origin of the respective codes at step 4.

CLC has 45 different classes. The values of the raster pixels were changed to consecutive numbers (1-45) maintaining an external table with the original code and name of the CLC classes.

The NUTS raster pixel values were multiplied by 1000 and an external table with the code and name of the NUTS3, NUTS2 and NUTS1 regions was created.

Step 3: Intersection of Natura2000 layer, NUTS regions and CLC

Once the three Natura 2000 raster files were created, we should first join each of the Natura 2000 raster layer, the NUTS regions and the CLC with the multiplication operation. That way, the Natura2000 rasters will include information of NUTS regions and CLC classes.

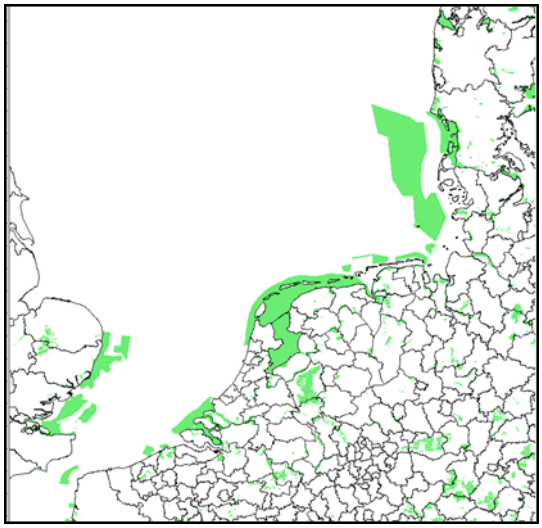

Figure 6 - Special Protection Areas (SPA), 100m

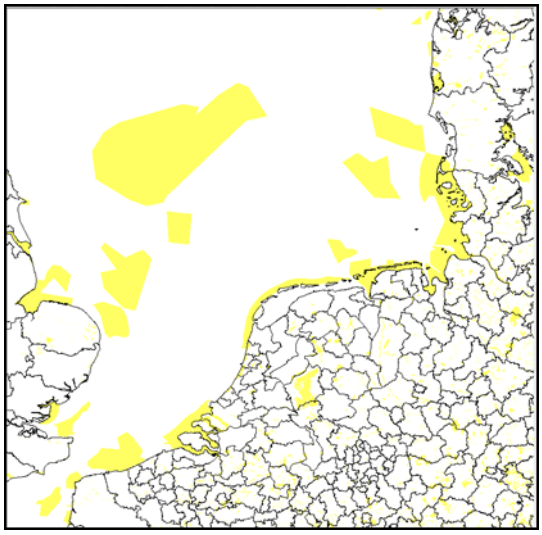

Figure 7- Sites of Community Importance (SCI), 100m

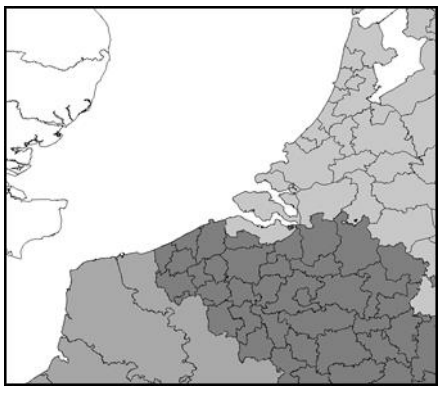

Figure 8 - NUTS regions, 100m

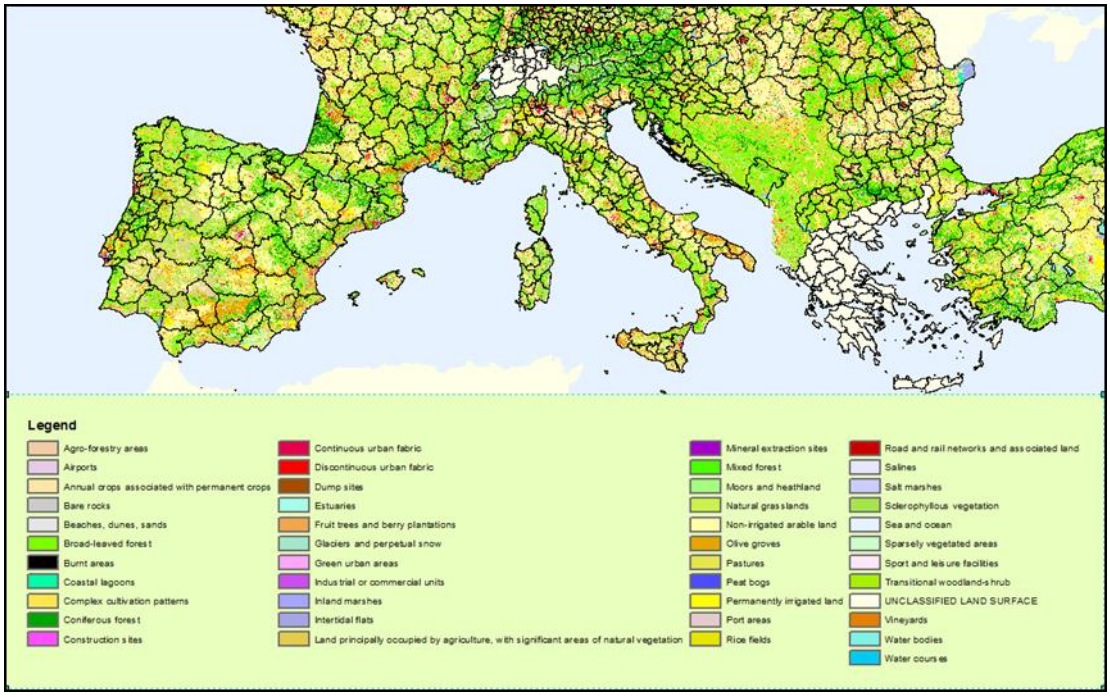

Figure 9 - Corine land cover, 100m

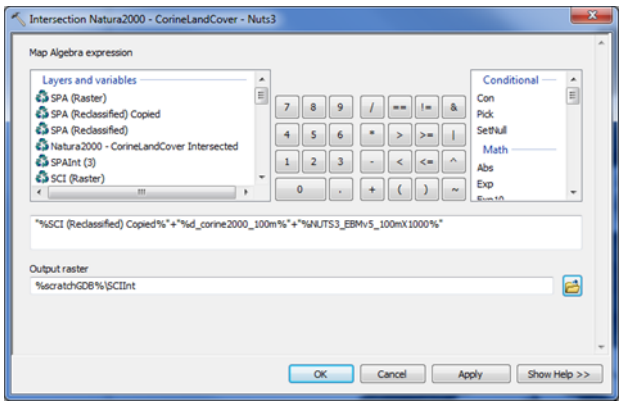

Figure 10 - Intersection by multiplication operation

Step 4: Disaggregation of the value by NUTS3 region, Natura 2000 and CLC class and respective joins to recover their alphanumeric values

After the intersection and multiplication in step 3, the information on the NUTS region code and the CLC class code is lost. To recover the codes, the seven digit raster values are divided in NUTS3 region with four digits, one digit for site raster (1) or not (0) and the last two digits for the CLC classification.

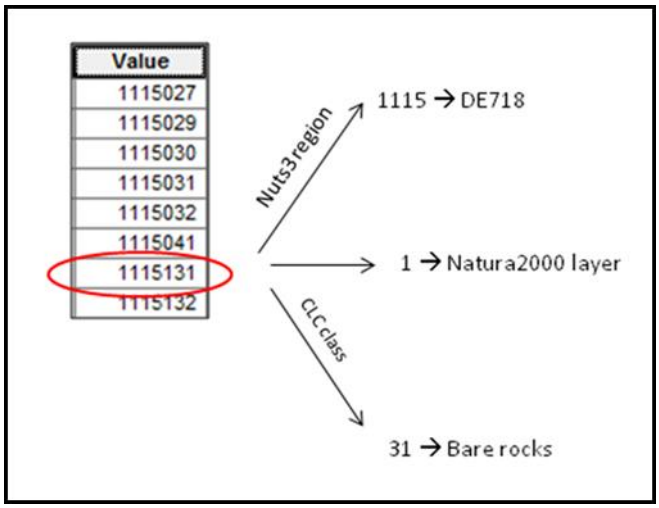

Figure 11 - Raster value disaggregation

ADM_ID	LABEL *	COUNTRY	SOURCE	NAME	LEVEL1_code	LEVEL2_code	LEVEL3_code
1000	DEG0C	DE	EBMv5-NUTS3	Gotha	DEG	DEG0	DEG0C
1001	DE127	DE	EBMv5-NUTS3	Neckar-Odenwald-Kreis	DE1	DE12	DE127
1002	AT323	AT	EBMv5-NUTS3	Salzburg und Umgebung	AT3	AT32	AT323
1003	FR246	FR	EBMv5-NUTS3	Loiret	FR2	FR24	FR246
1004	ITC33	IT	EBMv5-NUTS3	Genova	ITC	ITC3	ITC33
1005	DEB3F	DE	EBMv5-NUTS3	Kaiserslautern, Landkreis	DEB	DEB3	DEB3F
1006	DE233	DE	EBMv5-NUTS3	Weiden i. d. Opf, Kreisfreie Stadt	DE2	DE23	DE233
1007	HU211	HU	EBMv5-NUTS3	Fejér	HU2	HU21	HU211
1008	DE255	DE	EBMv5-NUTS3	Schwabach, Kreisfreie Stadt	DE2	DE25	DE255
1009	CH063	CH	EBMv5-NUTS3	Schwyz	CH0	CH06	CH063
1010	DE131	DE	EBMv5-NUTS3	Freiburg im Breisgau, Stadtkreis	DE1	DE13	DE131
1011	FR613	FR	EBMv5-NUTS3	Landes	FR6	FR61	FR613

Figure 12 - NUTS3 region table correspondence (ADM_ID - four digits)

Value_str *	
01	Continuous urban fabric
02	Discontinuous urban fabric
03	Industrial or commercial units
04	Road and rail networks and associated land
05	Port areas
06	Airports
07	Mineral extraction sites
08	Dump sites
09	Construction sites
10	Green urban areas
11	Sport and leisure facilities
12	Non-irrigated arable land
13	Permanently irrigated land
14	Rice fields
15	Vineyards
16	Fruit trees and berry plantations
17	Olive groves

Figure 13 - Corine land cover table correspondence (two digits)

Step 5: Area calculation in km2

Once the raster value is separated and joined with the respective tables to recover their initial values we must calculate the area of each site type, NUTS3 and CLC class in square kilometres. The intersection of the three rasters gave the amount of pixels of every different value (Count). We just have to convert them to square kilometres knowing that the size of every pixel is 100x100 meters.

OBJECTID *	Count	ZoneType	nuts3	natura	CLC	areakm2	nutsID
2960	19844	NAT	1115	0	25	198,44	<Null>
2961	873	NAT	1115	0	26	8,73	<Null>
2962	4712	NAT	1115	0	27	47,12	<Null>
2963	2408	NAT	1115	0	29	24,08	<Null>
2964	192	NAT	1115	0	30	1,92	<Null>
2965	3263	NAT	1115	0	31	32,63	<Null>
2966	2328	NAT	1115	0	32	23,28	<Null>
2967	65	NAT	1115	0	41	0,65	<Null>
2968	1	NAT	1115	1	31	0,01	SI022
2969	2	NAT	1115	1	32	0,02	SI022
199	112	SCI	1116	0	01	1,12	<Null>
200	12712	SCI	1116	0	02	127,12	<Null>
201	206	SCI	1116	0	03	2,06	<Null>

Figure 14 - Area calculation in km2

Step 6: Merge of tables per site type by Member State and export to excel

When the results are ready in a table format for each Member State, all tables are merged per site type.

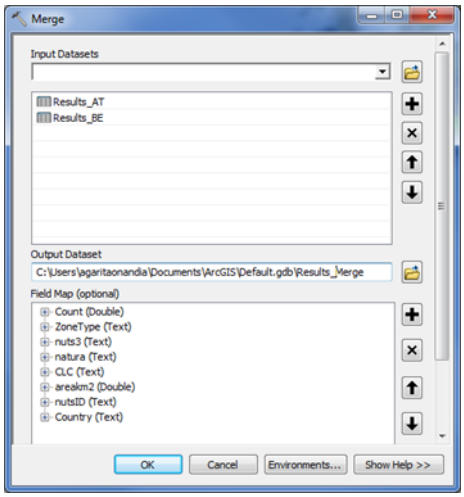

Figure 15 – Merged per site type

As some of the Natura 2000 shapefile could intersect with a different Member State than what it belongs to, these areas are removed from the final table.

nuts3	natura	CLC	areakm2	nutsID	Country
1045	1	18	0,08	SK021	AT
1045	1	23	0,22	SK021	AT
1045	1	29	0,04	SK021	AT
1045	1	18	0,08	SK021	AT
1045	1	23	0,22	SK021	AT
1045	1	29	0,04	SK021	AT
1045	1	18	0,08	SK021	AT
1045	1	23	0,18	SK021	AT
1045	1	29	0,04	SK021	AT
1710	1	02	0,02	SK010	AT
1710	1	12	0,24	SK010	AT

Figure 16 – The example shows the Natura 2000 shapefile attribute table with conflicting MS information of Slovakia and Austria.

Finally, the merged tables are exported to excel format file.

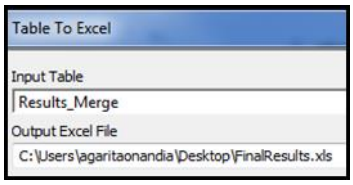

Figure 17 - Export to excel format file

4 Output datasets

The output will be the excel format table with the areas calculated per site type, NUTS region and CLC class.

ZoneType	areakm2	CLC_name	nuts3_id	nuts3_name	nuts2_id	nuts2_name	nuts1_id	nuts1_name	nuts0_id
SCI	42.31	28 Sclerophyllous vegetation	FR826	Vaucluse	FR82	Provence-Alpes-Côte d'Azur	FR8	Méditerranée	FR
SPA	42.31	27 Moors and heathland	UKL13	Conwy and Denbighshire	UKL1	West Wales and The Valleys	UKL	UKL	UK
NAT	42.34	25 Mixed forest	RO313	Dâmbovița	RO31	Sud - Muntenia	RO3	Macroregiunea Trei	RO
SCI	42.34	25 Mixed forest	RO313	Dâmbovița	RO31	Sud - Muntenia	RO3	Macroregiunea Trei	RO
NAT	42.39	25 Mixed forest	DEB24	Daun	DEB2	Trier	DEB	Rheinland-Pfalz	DE
NAT	42.4	25 Mixed forest	FR102	Seine-et-Marne	FR10	Île de France	FR1	Île de France	FR
SPA	42.4	21 Land principally occupied by agriculture	ES708	Lanzarote	ES70	Canarias	ES7	Canarias	ES
SCI	42.41	23 Broad-leaved forest	DE406	Dahme-Spreewald	DE40	Brandenburg	DE4	Brandenburg	DE
SCI	42.42	23 Broad-leaved forest	LT004	Marijampolės apskritis	LT00	Lietuva	LT0	Lietuva	LT
SCI	42.42	24 Coniferous forest	ITI17	Pisa	ITI1	Toscana	ITI	Centro (IT)	IT
SCI	42.43	18 Pastures	PL516	Legnicko-Głogowski	PL51	Dolnośląskie	PL5	Region Południowo-Zachodni	PL
NAT	42.43	24 Coniferous forest	GR127	Χαλκιδική	GR12	Κεντρική Μακεδονία	GR1	Βόρεια Ελλάδα	GR
SPA	42.46	27 Moors and heathland	UKK22	Dorset CC	UKK2	Dorset and Somerset	UKK	UKK	UK
NAT	42.48	12 Non-irrigated arable land	LT00A	Vilniaus apskritis	LT00	Lietuva	LT0	Lietuva	LT
NAT	42.48	20 Complex cultivation patterns	BG312	Монтана	BG31	Северозападен	BG3	Северна и Югоизточна България	BG
SCI	42.49	18 Pastures	PT171	Grande Lisboa	PT17	Lisboa	PT1	Continente	PT
SPA	42.5	12 Non-irrigated arable land	PL216	Oświęcimski	PL21	Małopolskie	PL2	Region Południowy	PL
NAT	42.5	31 Bare rocks	HR031	Primorsko-goranska županija	HR03	Jadranska Hrvatska	HR0	Hrvatska	HR
SPA	42.5	18 Pastures	FR615	Pyrénées-Atlantiques	FR61	Aquitaine	FR6	Sud-Ouest	FR
NAT	42.51	20 Complex cultivation patterns	FR615	Lot	FR62	Midi-Pyrénées	FR6	Sud-Ouest	FR

Figure 18 - final result table

This table was transformed to a pivot table, with the NUTS regions in vertical axis, CLC classes in a horizontal axis and filtered by site type.

ZoneType: NAT

Area km2	Corine Land Cover							
NUTS	01 Continuous urban fabric	02 Discontinuous urban fabric	03 Industrial or commercial units	04 Road and rail networks and associated land	05 Port areas	06 Airports	
AT	0.05	166.38	2.06	0.29	0.95	1.76	
BE		90.73	19.49	3.67	11.12	10.28	
BG		388.48	59.71	4.84	2.38	2.87	
CY		0.85	1.23			0.04	
CZ	0.01	124.69	10.07	0.63		0.05	
DE	0.68	232.52	29.03	3.83	2.22	14.61	
DK	0.05	7.19	0.18	0.97	0.16	0.18	
EE		9.14	2.48	0.57	0.18		
ES	60.84	149.26	30.27	9.42	0.8	4.48	
FI		28.17	0.99		0.06	0.43	
FR	4.1	501.99	48.92	23.59	2.67	8.92	
GR	3.01	156.75	27.92	9.28	0.34	4.55	
HR	0.03	176.87	8.91	24.14	0.15	0.46	
HU	0.01	40.92	11.23	2.24		8.12	
IE	0.67	10.55	1.04	0.15	0.09	1.39	
IT	25.18	189.88	37.11	3.07	2.46	13.36	
LT		16.96	3.22	0.41		0.39	
LU		4.77	0.09	0.81	0.01	0.01	
LV		26.73	5.15	0.01	0.01		
MT		1.39					
NL		7.02	3.56	2.24	1.18	1.71	
PL	0.37	405.56	17.77	5.59	1.67	6.64	
PT	1.16	108.34	11.07	1.78	2.24	2.62	
RO		430.41	55.33	1.54	1.89		
SE		9.61	1.34	2.3	0.01	0.33	
SI	0.06	25.33	2.09	2.95		0.08	
SK	0.02	38.42	5.18	1.19			
UK	0.21	19.41	7.72	0.8	2.43	3.3	
Total	96.45	3348.52	405.16	106.31	33.02	106.58	

Figure 19 - Final pivot table

5 Appendix (Model builder)

Step 1: Select by country and site type, rasterise and reclassify Natura 2000 shapefile.

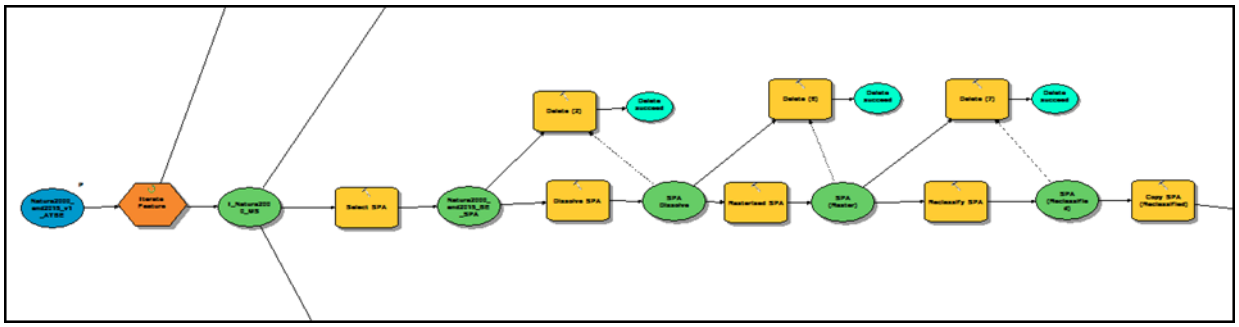

Figure 20 - Model builder Step 1

Step 2: Intersection between rasterised Natura 2000, Corine Land Cover and NUTS3 layers

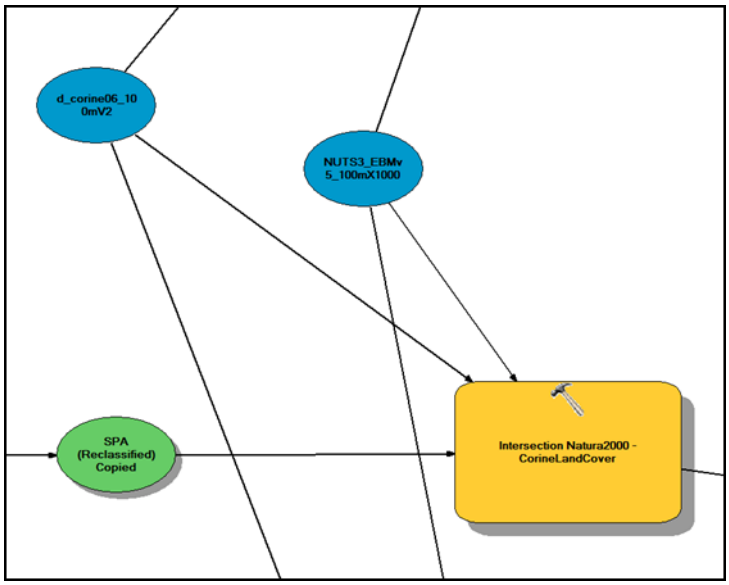

Figure 21 - Model builder Step 2

Step 3: Area Calculation

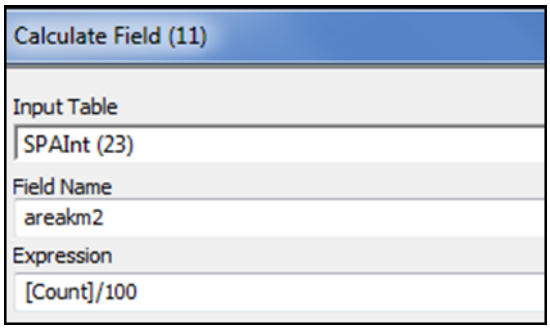

Figure 22 - Model builder Step 3

Step 4: Decomposition of the raster value and recovery of NUTS3 code

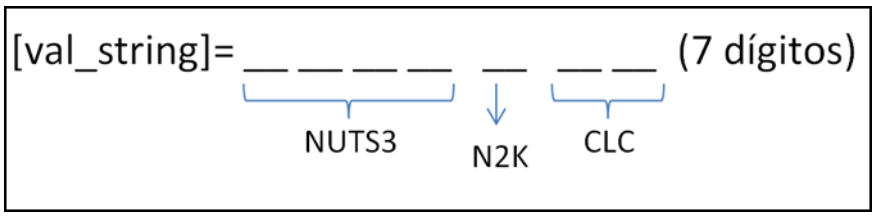

Figure 23 - Model builders step 4a

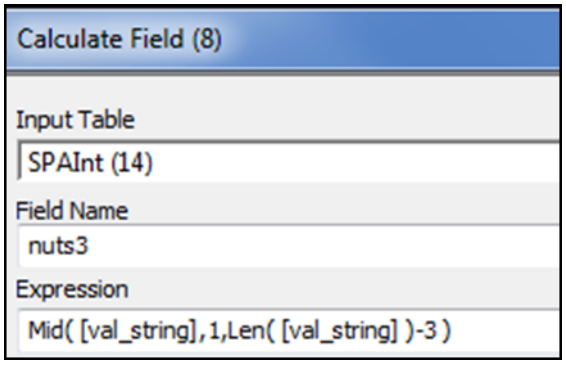

Figure 24 - Model builder Step 4b

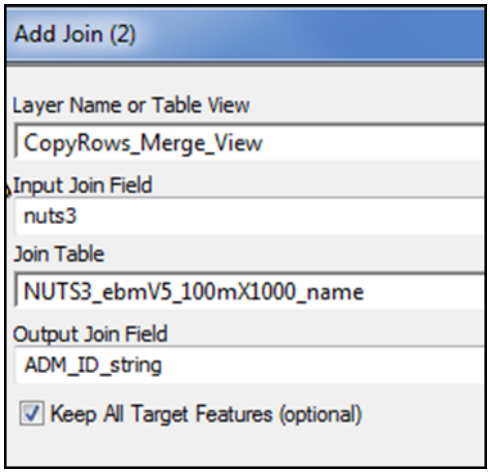

Figure 25 - Model builder Step 4c