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Methodological note and tests of mapping of pressure hotspots on EU grasslands

Ľuboš Halada, Juraj Lieskovský and Sophie Condé

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Authors' affiliation:

Ľuboš Halada, Institute of Landscape Ecology of the Slovak Academy of Sciences (SK)
Juraj Lieskovský, Institute of Landscape Ecology of the Slovak Academy of Sciences (SK)
Sophie Condé, Muséum national d'Histoire naturelle (FR)

EEA project manager:

Markus Erhard, Environment European Agency (DK)

ETC/BD production support:

Muriel Vincent, Muséum national d'Histoire naturelle (FR)

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European Topic Centre on Biological Diversity
c/o Muséum national d'Histoire naturelle
57 rue Cuvier
75231 Paris cedex, France
Phone: + 33 1 40 79 38 70
E-mail: etc.biodiversity@mnhn.fr
Website: http://bd.eionet.europa.eu

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1 Introduction

This document is part of the task 2016 ETC BD Action plan, task 175A Biodiversity assessments including in support to EU Biodiversity Strategy target 2 action 5, part III. Agriculture related issues (EEA project 1.7.6).

The aim is to „explore how to develop maps of EU grasslands showing hotspots of specific pressures using Article 17 database". The work should result in development of the methodological note and tests of mapping of pressure hotspots on EU grasslands. This task is assigned to ILE SAS. It is expected to produce a note that will describe the optional methods including pros and cons.

This draft version 0.3 of the report should provide the input information to EEA and to discuss different approaches to the task and to get recommendations for next work in this issue.

2 Methodology

2.1 Data

Based on requirements of Article 17 of the Habitats Directive and Article 12 of the Birds Directive, the EU Member States (MS) are obliged to report on the conservation status of habitat types and species listed in the annexes of the Directives. The most recent reports were provided in 2013 by 27 MS (Croatia as a new EU member was not obliged to report) and they cover period 2007-2012 (Habitats Directive) and 2008-2012 (Birds Directive). The individual national reports were merged to databases in format MS Access containing data from EU27. Besides the databases, the MS delivered also distribution maps of the species and habitat types. The distribution maps are grid maps with the grid cell size 10 x 10 km.

The national Art17/Art12 reports contain also information about threats and pressures influencing the species and habitats, the intensity of each threat/pressure is specified in three levels: L – low; M – medium; H – high. The MS are reporting threats/pressures[1] for each Biogeographical region occurring in their respective territory. The MS distinguish in their reports threats and pressures, in the present document we will deal with pressures only.

The hierarchical system is used for the pressures classification containing 396 pressures organised in 17 groups of pressures of level 1 (see Table 2.1). The system contains 75 pressures on level 2, 209 pressures on level 3, and 112 pressures on level 4.

Table 2.1: Groups of pressures on level 1

Code	Pressure category
A	Agriculture
B	Sylviculture, forestry
C	Mining, extraction of materials and energy production
D	Transportation and service corridors
E	Urbanisation, residential and commercial development
F	Biological resource use other than agriculture & forestry
G	Human intrusions and disturbances
H	Pollution
I	Invasive, other problematic species and genes
J	Natural System modifications
K	Natural biotic and abiotic processes (without catastrophes)
L	Geological events, natural catastrophes
M	Climate change
U	Unknown threat or pressure
X	No threats or pressures
XE	Threats and pressures from outside the EU territory

[1] For Article 17 pressures are considered to be factors which are acting now or have been acting during the reporting period, while threats are factors expected to be acting in the future.

Code	Pressure category
XO	Threats and pressures from outside the Member State

The task is focused to agriculture-related issues and from this aspect we can divide pressures to two big groups: agricultural (group A) and non-agricultural ones (all other). We consider this division useful because it helps to distinguish pressures related to the agricultural management of the land from pressures related to other human activities and to natural processes. The pressures of group A can be eliminated by modification of agricultural practices.

The group A contains 15 pressures related to intensification or intensive use of agricultural land on levels 3 and 4 (Tab. 2.2), 4 pressures related to abandonment or too low intensity of the agricultural use (Tab. 2.3) and 24 types of pressures related to other agricultural practices unsuitable for the respective species/habitat (Tab. 2.4). We propose to use in further analysis three sub-groups of "agricultural pressures" i.e. intensification (I), abandonment (Ab) and other unsuitable use (U).

Tab. 2.2: Pressures related to the intensive use of agricultural land or to intensification (I)

Code	Pressure
A02.01	agricultural intensification
A02.03	grassland removal for arable land
A03.01	intensive mowing or intensification
A04.01	intensive grazing
A04.01.01	intensive cattle grazing
A04.01.02	intensive sheep grazing
A04.01.03	intensive horse grazing
A04.01.04	intensive goat grazing
A04.01.05	intensive mixed animal grazing
A06.01.01	intensive annual crops for food production/ intensification
A06.02.01	intensive perennial non-timber crops/intensification
A06.03	biofuel-production
A07	use of biocides, hormones and chemicals
A08	Fertilisation
A09	Irrigation

Tab. 2.3: Pressures related to the abandonment of agricultural management of land (Ab)

Code	Pressure
A03.03	abandonment / lack of mowing
A04.03	abandonment of pastoral systems, lack of grazing
A05.03	Lack of animal breeding
A06.04	abandonment of crop production

Tab. 2.4: Pressures related to other unsuitable use (U)

Code	Pressure
A01	Cultivation
A02	modification of cultivation practices
A02.02	crop change
A03	mowing / cutting of grassland
A03.02	non intensive mowing
A04	grazing
A04.02	non intensive grazing
A04.02.01	non intensive cattle grazing
A04.02.02	non intensive sheep grazing
A04.02.03	non intensive horse grazing
A04.02.04	non intensive goat grazing
A04.02.05	non intensive mixed animal grazing
A05	livestock farming and animal breeding (without grazing)
A05.01	Animal breeding,
A05.02	stock feeding
A06	annual and perennial non-timber crops
A06.01	annual crops for food production
A06.01.02	non- intensive annual crops for food production
A06.02	perennial non-timber crops
A06.02.02	non-intensive perennial non-timber crops
A10	Restructuring agricultural land holding
A10.01	removal of hedges and copses or scrub
A10.02	removal of stone walls and embankments
A11	Agriculture activities not referred to above

2.2 Levels of pressures classification to be used

The first decision to be taken is level of pressures classification in which we wish to work. This decision has crucial influence to the results of analyses. The list of pressures is hierarchical, having 4 hierarchical levels (e.g. A is level 1, A01 is level 2, A01.01 is level 3, A01.01.01 is level 4). The Member Countries were obliged to report pressures at least on level 2, while the use of levels 3 and 4 was voluntary. However, quite high number of countries used level 4 for pressures reporting, some other used level 3. Often different levels were used in reporting of the same country. This makes problems with comparability of data and with further quantitative analysis. We considered several options:

1. Use of level 2. This option needs conversion of all pressures reported on levels 3 and 4 to level 2. Then it is necessary to remove duplicates that occurred as result of conversion of several pressures on lower level to the same pressure on level 2. Use of level 2 has an important advantage: it enables to use homogenous data as all pressures are reported on the same hierarchical level. On the other hand, certain diversity of pressures is lost, the situation is generalised. But more important is another consequence of conversion to level 2: it does not allow to distinguish between crucial agricultural groups of pressures – abandonment and intensification. This distinction is possible on levels 3 and 4 only.
2. Use of level 3. This option needs conversion of pressures reported on level 4 to level 3. Pressures, reported on level 2 remain in that level. As a result, the database contains mixture of pressures on levels 2 and 3. In this way the ability to distinguish agriculture abandonment and intensification remains available, but only for part of data (those reported on levels 3 and 4). The final statistic is influenced by level of reporting by individual countries, but this dependence is lever than in option 3 below.
3. Use of level 4. This option does not need any conversion of data and it is possible to work with full spectrum of pressures. However, the data are heterogeneous because all there levels (2, 3, 4) remain in the database. Thus it can happen that one country reports five related pressures using level 4 as five pressures while other country reports the same five pressures on level 2 as one pressure. The final statistics then depends significantly on reporting level used by individual countries. The ability to distinguish agriculture abandonment and intensification is maintained (except pressures reported on level 2).

Taking into account advantages and disadvantages of all three options, we decided to adopt option 2, i.e. **to work on level 3.** This still enables us to distinguish agriculture abandonment, intensification and other pressures and in the same moment the data heterogeneity is lower than in option 3 (use level 4, i.e. all levels reported).

2.3 The relevant habitat types and species

The task is focused to agricultural issues, therefore the analysis should be focused to species linked mostly to the agricultural landscapes and habitats depending on agricultural practices. The list of **habitat types of European importance depending on agricultural practices** published Halada et al. (2011). This list includes 63 habitat types (see Annex 1) that depend on or which can profit from agricultural activities. The list is related to 27 MS and thus we will use this list in the analysis.

The list distinguish habitat types fully dependent on agricultural management (D); habitat types partially dependent (P) that profit from agricultural management that usually blocks secondary succession; habitat types for which the relationship with extensive farming practices holds true for only some sub-types or for part of their distribution (M). It is possible to distinguish all these groups and perform three types of analysis:

- on the full list of 63 habitats per type of management descriptors (D+P+M) ;
- on the list limited 31 Grasslands habitats (6XXX) per type of management descriptors (D+P+M);
- on the selection of 23 D habitats with making distinction between Dunes, Heathlands, Grasslands.

For the second option above (grassland types) will be good to decide if to include to analysis also a few grassland habitat types that do not depend on agricultural management.

The ETC BD assessed in previous years **links between species listed in annexes of the Habitats Directive and main ecosystem types** (Roscher et al., 2015). This assessment included also links to three types of agricultural habitats: cropland, agricultural mosaics, and grassland. In this assessment we will not work with cropland, but besides grasslands the analysis will include also agricultural mosaics. Therefore it is possible to work with both groups and to prepare separate analyses for 1) grasslands only and 2) for grasslands+agricultural mosaics. The strength of the link between species and ecosystem type was expressed in three categories: preferred ecosystem; suitable ecosystem; occasional ecosystem. We will reflect these categories in our analysis.

For bird species it is possible to use the bird species that were selected for the farmland birds indicator (see Annex 3). This list includes species linked both to cropland and grasslands.

We focused the analysis presented in this document to habitats, depending on agricultural practices (Halada et al, 2011) and we distinguished habitat types fully (D) and partially (P) depending on agricultural practices. In the further analysis, it is possible to use approved/agreed methodological approach to any selection of species or habitat types.

2.4 Which spatial units?

Biogeographical regions within their respective countries represent the spatial units for reporting by Member States (further "reporting units"). Thus, all data related to the assessment of the conservation status of species and habitats, including pressures, are related to these spatial units. It is therefore possible to develop pressures statistics directly for these spatial units and to display results on the maps. However, these maps have quite coarse spatial resolution.

The MS reported distribution of individual habitat types and species using grid maps with the grid cell of size 10x10 km. It is possible to assign pressures to whole distribution of particular species or habitat type in the respective reporting unit. By overlay of layers of different habitats and species it is possible to map pressures in a cumulative way and to identify hotspots of pressures. However, in such way it is possible to map only potential pressures because we know that pressures to habitat/species operate in the reporting unit, but we do not know if they operate in whole reporting unit or only in its part and if the pressure intensity is uniform or variable across the reporting unit.

2.5 How to quantify threats/pressures?

Some other decisions need to be done in beginning of evaluation. We list them below and provide comments, including information how we decided in the analysis described in this document.

- *If to consider all pressures or to exclude from analysis low-intensity pressures*

The low-intensity pressures are often considered as not important and the focus is to high- and medium intensity pressures. If considering not important, they could be exclude from further analysis. The fact that they impact habitats or species (even with low intensity) speaks against their exclusion. On the other hand, if is calculated number of pressures or number of habitats influenced by pressures, they have the same value as high- or medium intensity pressures, what distorts the overall picture. In our analysis described in this document we kept low-intensity pressures in the database and used them in calculations.

- *If to use number of pressures in each category of intensity or to calculate index*

When distinguishing intensity of pressures, it is possible to count number of pressures in each category of intensity (low, medium, high) and to receive three numbers (one for each category) or to calculate index that includes all categories and thus receive one value. We decided to calculate and index.

- *If to use weights for intensity of pressures or consider equal intensity*

This question is related to calculation of the pressure index. If no weights are used, each pressure is considered equally important. For considering differences in intensity, it is possible to assign to each category of intensity certain weight – lowest to low intensity, highest to high intensity. We took the second approach and used coefficient 1 for low intensity, 2 for medium intensity and 3 for high intensity of pressure. The weight to be used could be discussed further – it is possible to highlight importance of higher intensities of pressures by higher coefficients – e.g. coefficient 1 for low, 3 for medium and 5 for high pressures or 1-5-9.

- *How to deal with pressures influencing several habitats or species?*

It is quite often that one pressure impacts several habitat types or several species. When calculating impact of pressures to group of habitats or group of species, two approaches could be taken: 1) the respective pressure is counted only one time despite influencing several habitats/species; 2) the respective pressure is counting several times depending on number of impacted habitats/species. In the second case, the cumulative impact index could be calculated. This approach could highlight hotspots of pressures – places where high number of pressures impacts high number of species/habitats. In the analysis described in this document, we used the first approach – each pressure was counted only one time with intensity corresponding to the highest intensity reported. However, the use of the second approach in the future works needs to be considered.

As visible from the above text, there are a lot of opportunities how to analyse and quantify pressures and the decisions should be taken in relation to aims of analysis. There are several alternative approaches to quantification of pressures; probably not all of them are equally useful. We specified our decisions for the presented analysis, but it is necessary to discuss them in the next process and to select suitable options for the future analyses.

2.6 Workflow for maps preparation

Based on decisions taken that are described in the previous chapters, we developed following workflow for preparation maps.

Step 1: **Conversion of pressures to level 3.** Pressures in level 4 were converted to level 3, duplicates were identified and removed. We removed duplicates with lower intensity of pressure, only the highest reported intensity was kept for particular pressure. The result: database with pressures on both levels 2 and 3.

Step 2: **Assignment of individual pressures to groups of pressures**: I – intensification; Ab – abandonment; U – other unsuitable agricultural use; X – other, non-agricultural pressures (for full list see Annex below).

Step 3: **Calculation of number/index of pressures for a single habitat.** For each habitat type will be calculated:

a) Number of pressures in each category (Ab, I, U, X);
b) Index weighted by intensity of pressure (L= 1; M=2, H=:3) in each of 4 categories (Ag, I, U, X)

Result: a new database in which each habitat type is represented only by one line for each reporting unit (BGR/country combination). The database contains following new fields: Ab_number, I_number, U_number, X_number, Pressures_number, Ab_index, I_index, U_index, X_index, Pressures_index

Step 4: Calculation of composite pressure index for group of habitats. Summing of number of pressures and weighted indices of pressures for:

1) all 63 habitat types depending on agricultural practices;

2) habitats fully depending on agricultural practices (D);

3) habitats partially depending on agricultural practices (P).

Summing of number of pressures results in composite index of pressures that does not distinguish intensity of pressure. Summing of pressure indices of individual habitat types results in for composite index of pressures depending on the pressures intensity.

Result: a new database for three habitat groups listed above with values of 2 composite indices.

Step 5: Maps producing for biogeographical regions

Following types of maps could be prepared **from the habitat aspect**:

Number of pressures linked to: 1) intensification, 2) abandonment, 3) other agricultural pressures, 4) other non-agricultural pressures, 5) total number of pressures.

Pressures index for: 1) intensification, 2) abandonment, 3) other agricultural pressures, 4) other non-agricultural pressures, 5) overall index of pressures.

Each of these maps could be prepared for single habitat type or for group of habitats (e.g. those listed in Step 4).

Following types of maps could be prepared **from the pressure aspect:**

Distribution of pressures across EU – map for single pressure or group of pressures

Number of habitat types under particular pressure or group of pressures

Step 6: Maps producing for Article 17 distribution grid

In this step the maps resolution is downscaled from the level of the reporting unit to the grid cells of size 10x10 km used by the Member Countries for reporting distribution of habitats and species in the Article 17 reports (further "Article 17 grid"). Because the countries reported pressures on level of reporting units (biogeographical region in country), this step assumes that the particular pressure is operating in whole reporting unit with the same intensity. This assumption should be taken in the account when the results are interpreted and communicated – this step produces **maps of potential pressures** (we are not sure where exactly inside of the biogeographical region the individual pressures operate and in which intensity).

3 Results

In this chapter we provide results of our initial analysis using decisions specified in individual parts of chapter 2. As specified above, this analysis focuses to habitat types, depending on agricultural practices identified by Halada et al. (2011; see Annex 1). The list contains 63 habitat types that could be divided to habitat fully depending on agricultural practices (D - 23 habitats) and habitats partly depending on agricultural practices (P - 40 habitats). If we write in the next parts of the document about "all habitats", we understand all 63 habitat types listed in the Annex 1, otherwise we specify habitats fully (D) and partially (P) depending on agricultural practices. It means, we prepared maps for three sets of habitats: all 63 habitats; D – habitats, and P - habitats.

We distinguished pressures to level 3, what means that in the database used for analysis were represented pressures on both levels 2 and 3.

The chapter is divided into two parts – in the first one (chapter 3.1) we present results achieved using data with original spatial resolution of reporting units. The second part (chapter 3.2) contains results achieved using extrapolation of data to detailed spatial resolution- grid 10x10 km.

3.1 Maps for biogeographical regions

A – Number of habitat types in individual biogeographical regions within countries

We consider useful to provide overview of number of habitat types depending on agricultural practices in the reporting units (biogeographical regions in individual countries) and show it in next three maps. This overview is important for understanding maximal values that could be reached in individual reporting units in subsequent analysis and resulting maps.

Fig. 3.1: Number of habitats depending on agricultural practices occurring in individual reporting units

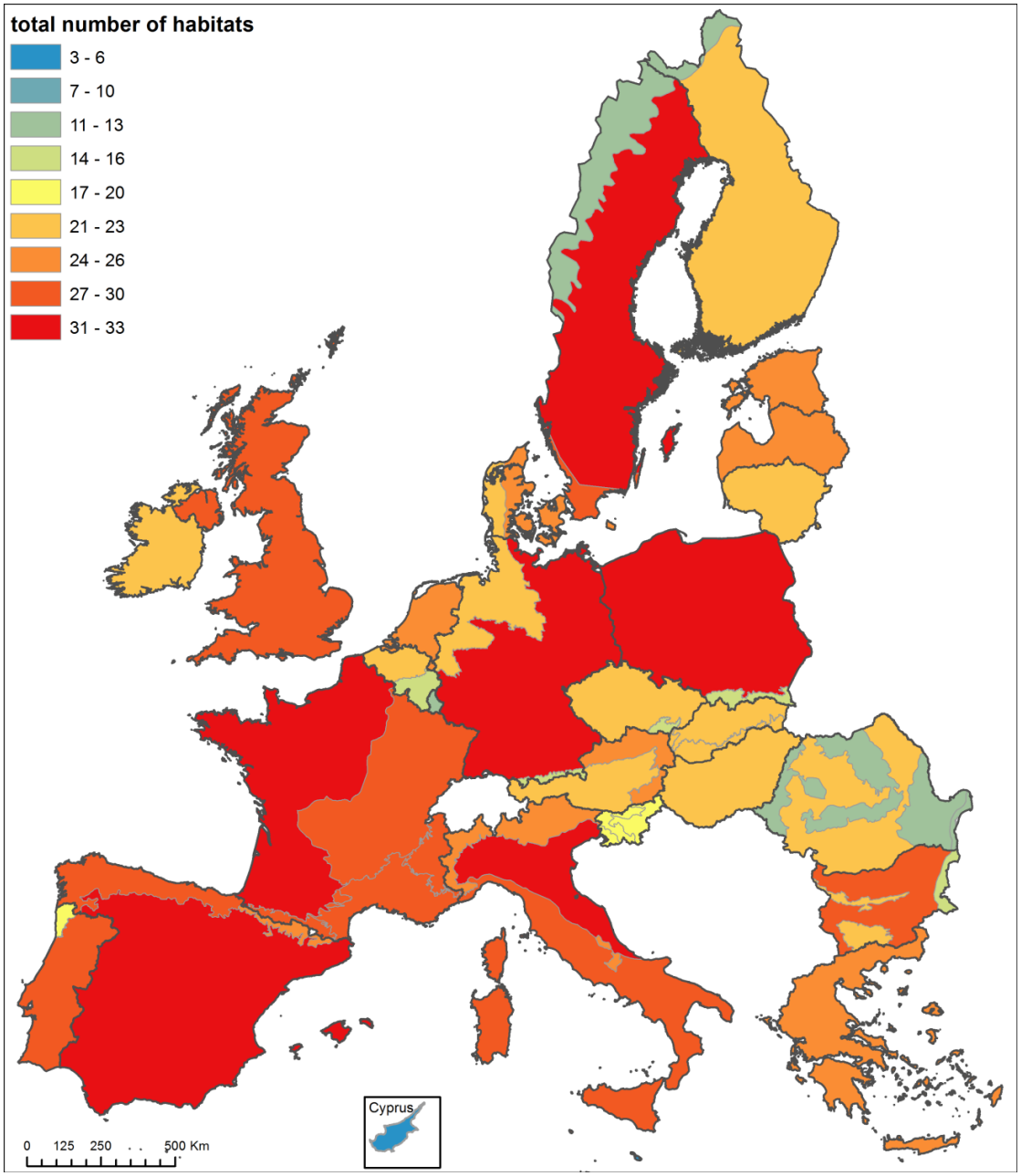


Fig. 3.2: Number of habitats fully depending on agricultural practices occurring in individual reporting units

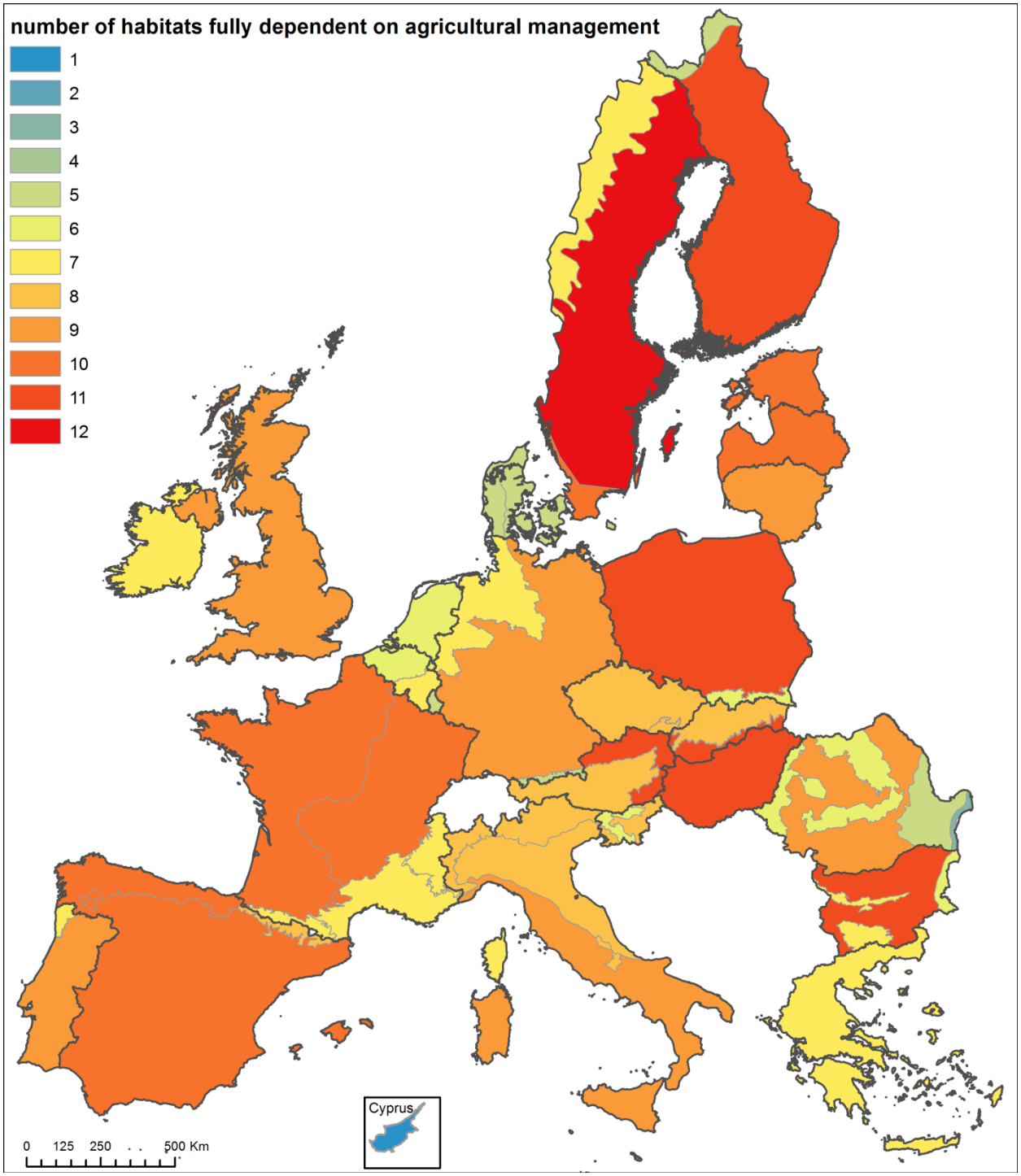
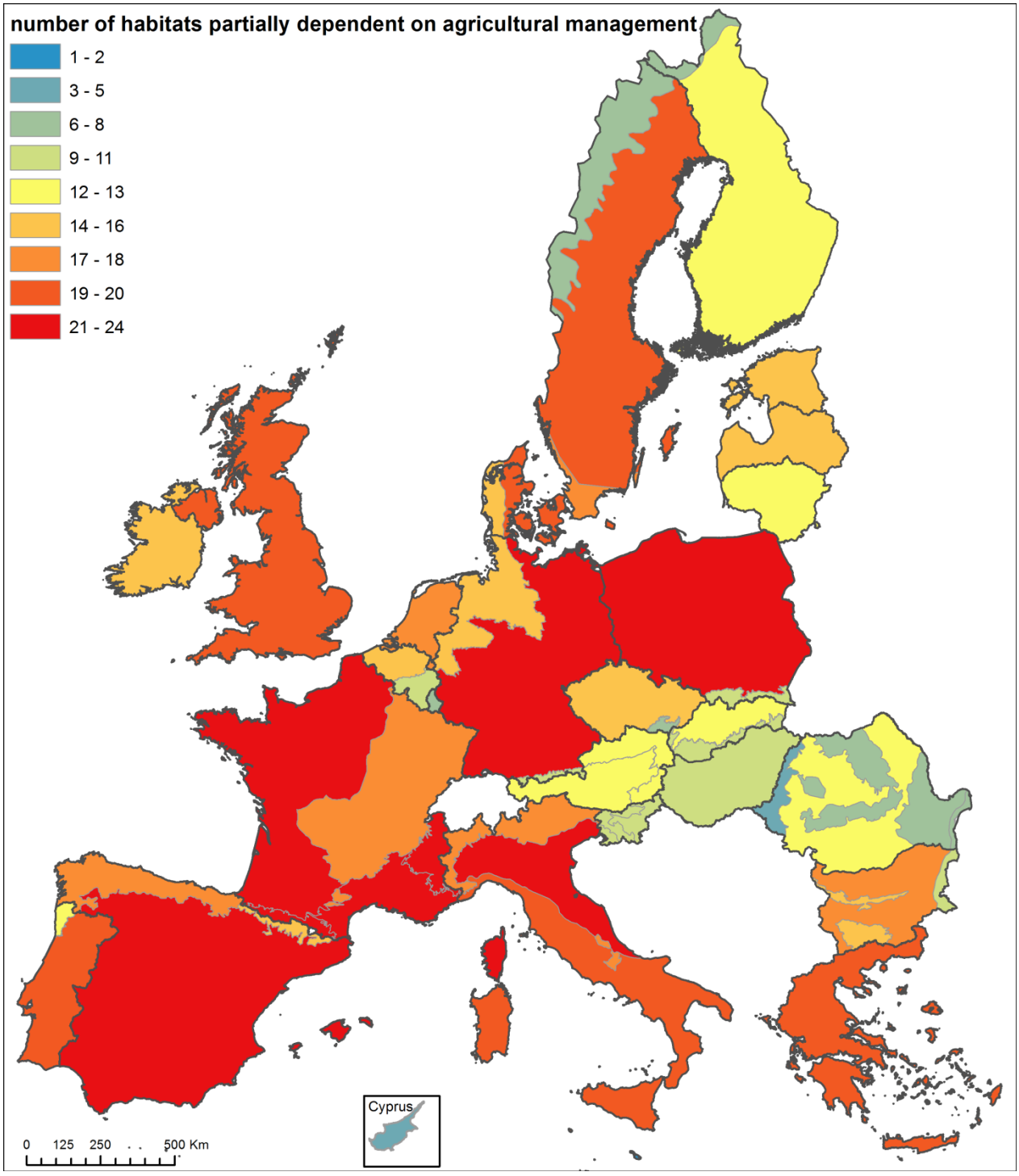


Fig. 3.3: Number of habitats partly depending on agricultural practices occurring in individual reporting units



B – Number of habitat types influenced by individual groups of pressures

The following maps show number of habitat types depending on agricultural practices (63 habitat types as identified in Halada et al., 2011) that are influenced by individual groups of pressures.

Fig. 3.4: Number of all habitats influenced by agriculture intensification (I)

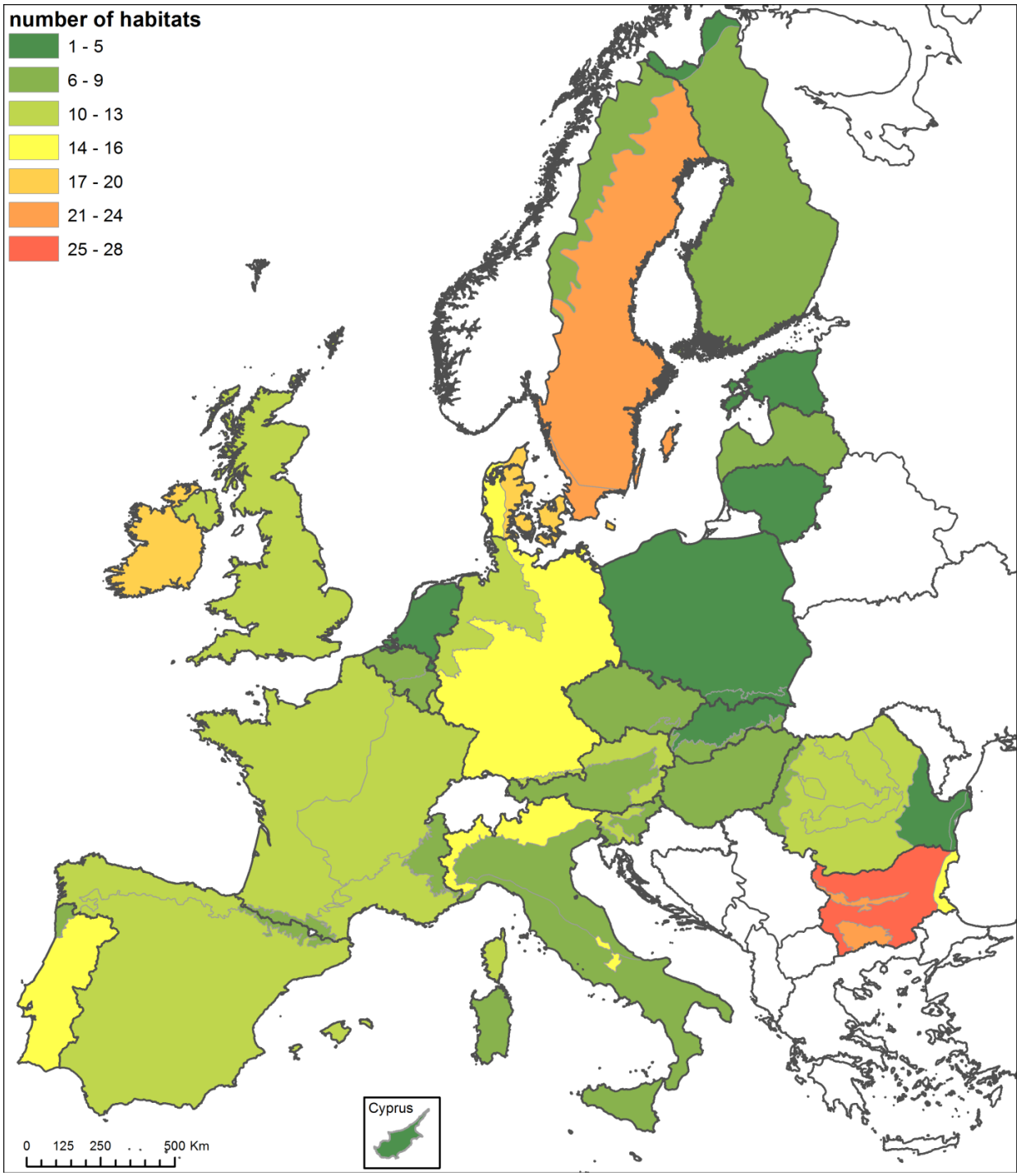
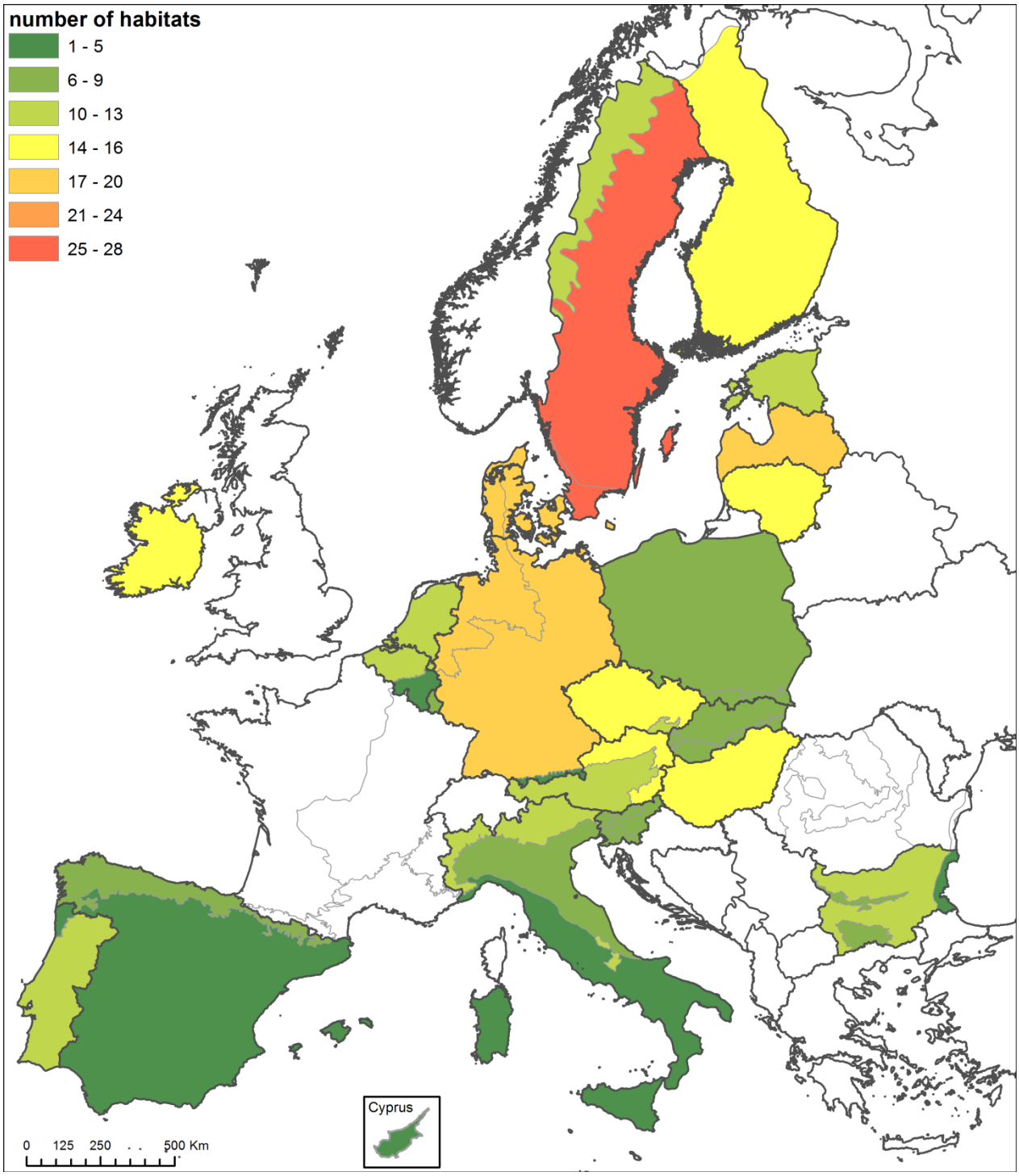


Fig. 3.5: Number of all habitats influenced by abandonment (Ab)



No Pressures reported at level 3 by FR, UK and RO explain they are in white (to be confirmed)

Fig. 3.6: Number of all habitats influenced by other agricultural pressures (U)

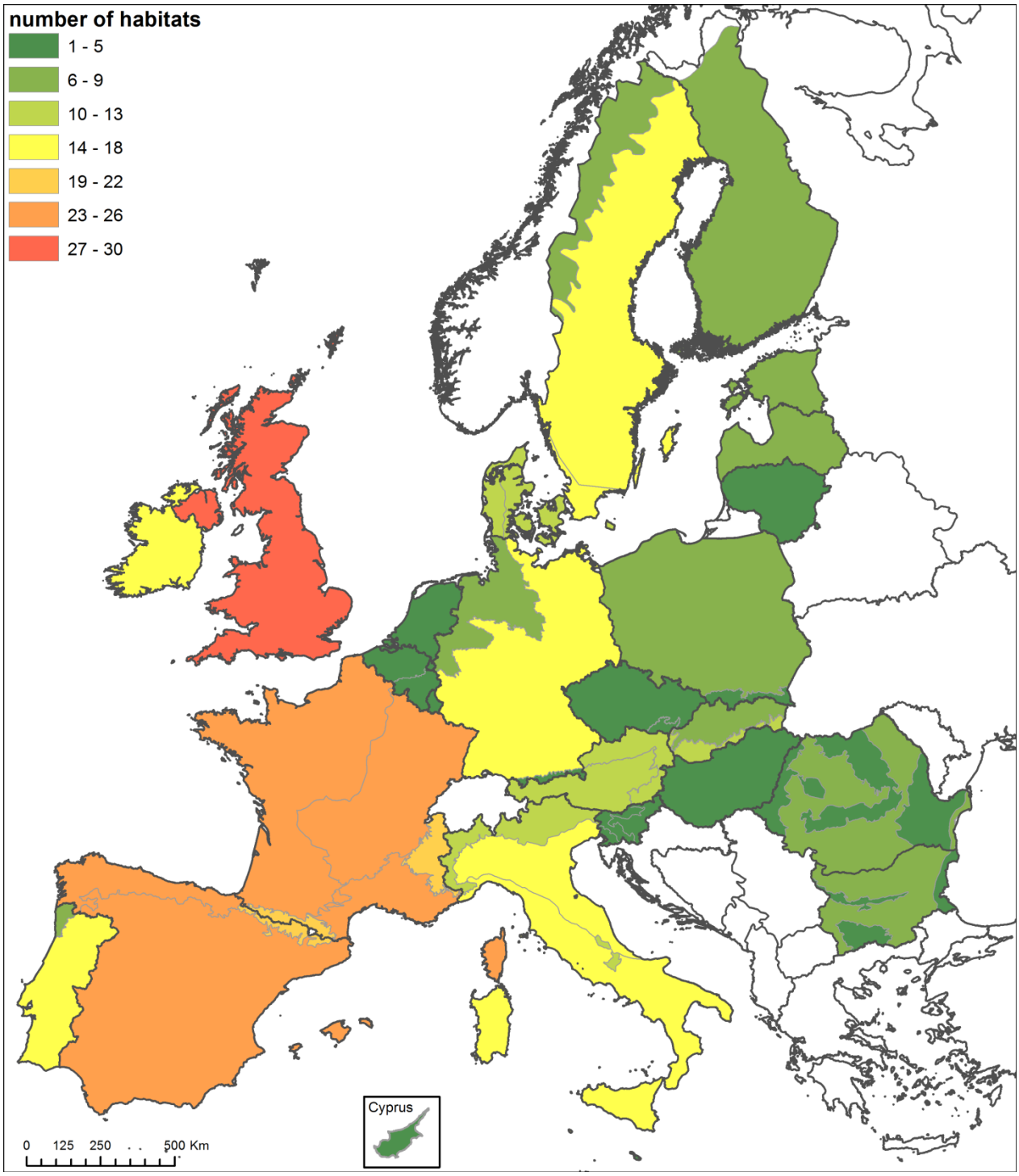
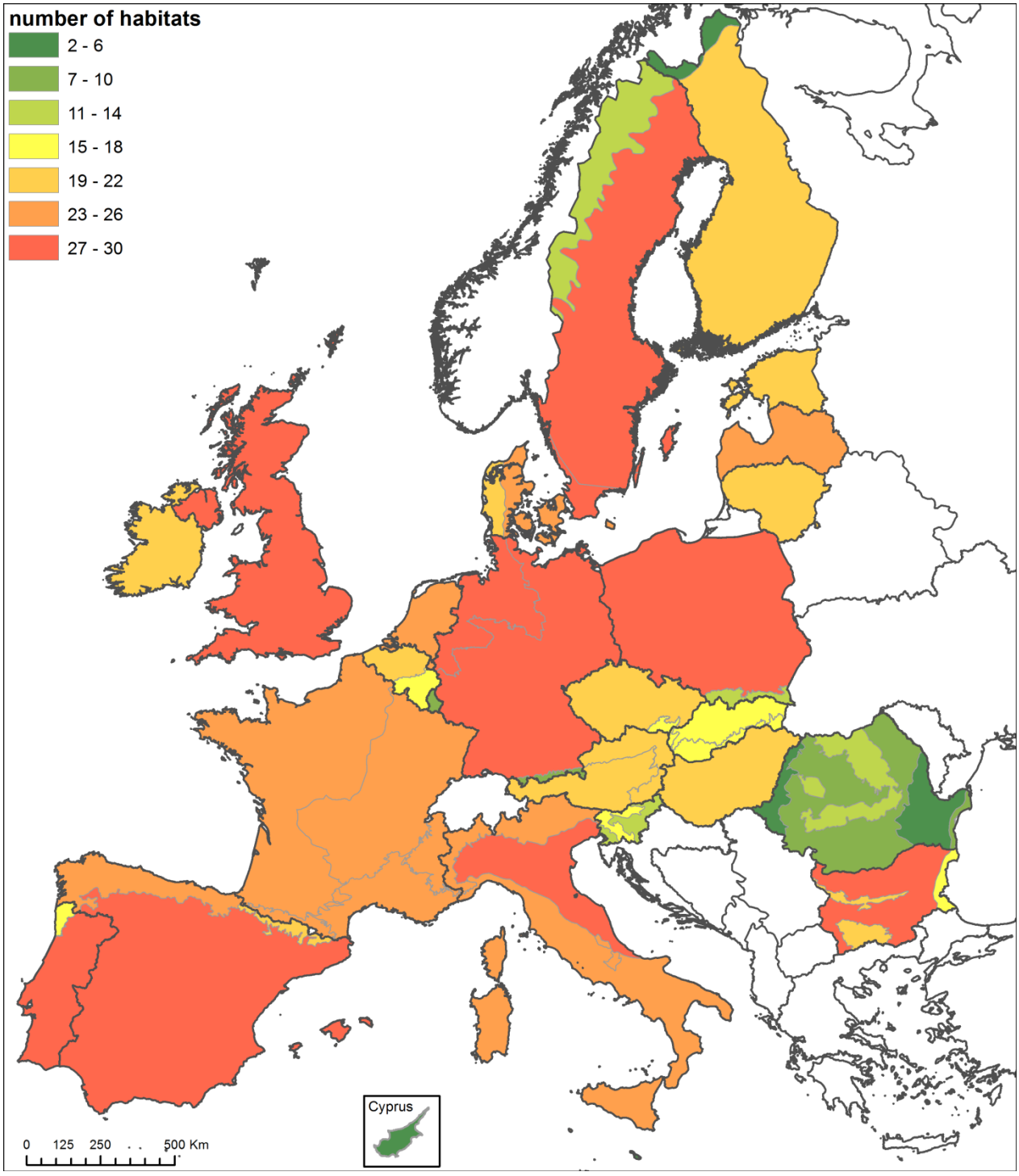


Fig. 3.7: **Number of all habitats influenced by non - agricultural pressures** (pressure code starting with other letter than A)



C – Number of pressures influencing habitats, depending on agricultural practices

Here we provide examples of maps showing number of agricultural pressures that influence habitats, depending on agricultural practices. We display only maps for agricultural pressures without dividing them to individual groups of pressures (intensification, abandonment, other agricultural pressures) and do not provide maps for non-agricultural pressures and all pressures. All these types of maps can be prepared if they will be find useful.

Fig. 3.8: **Number of agricultural pressures influencing all habitats depending on agricultural practices** (63 habitat types)

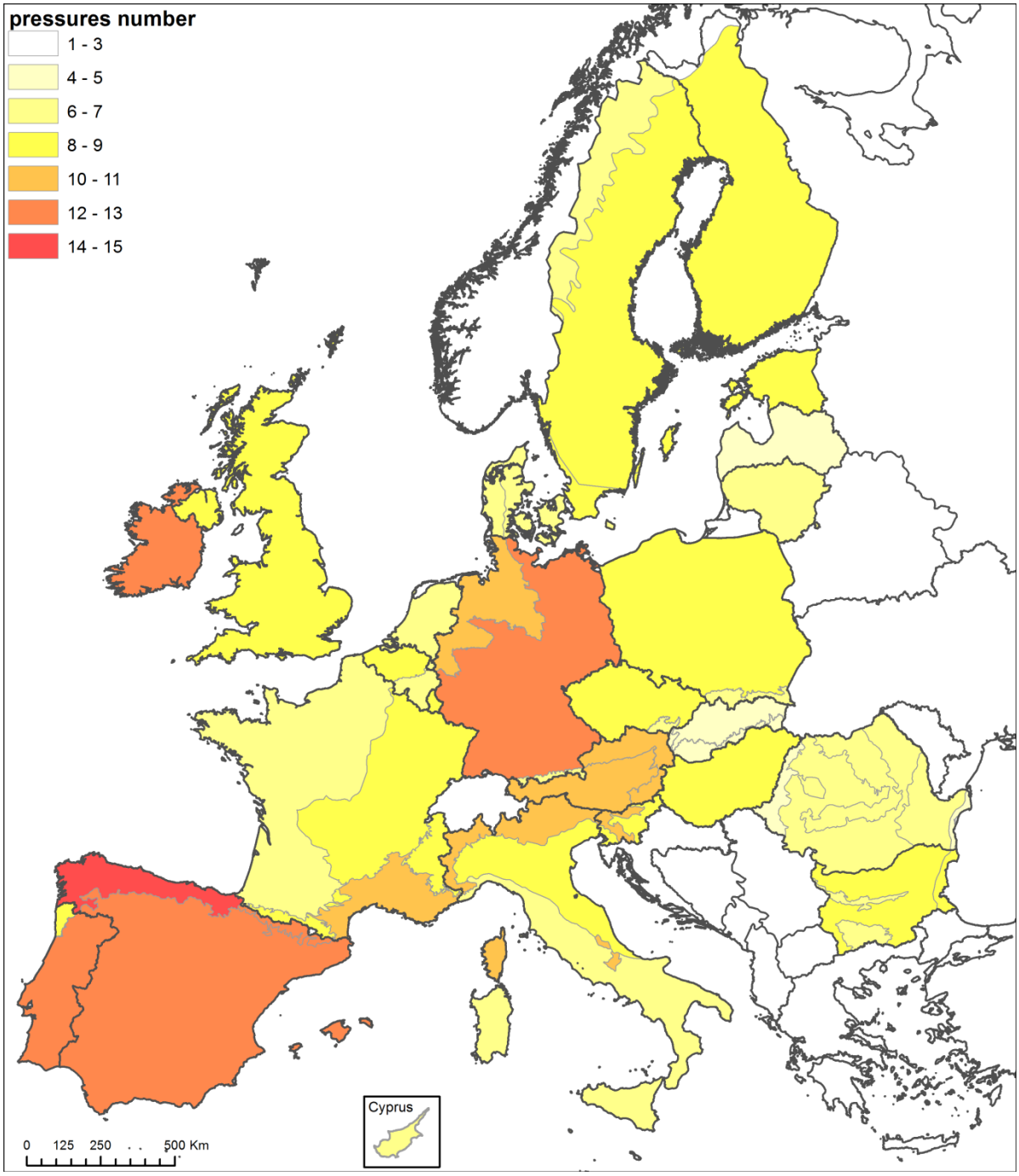


Fig. 3.9 **Number of agricultural pressures influencing habitats fully depending on agricultural practices** (23 habitat types)

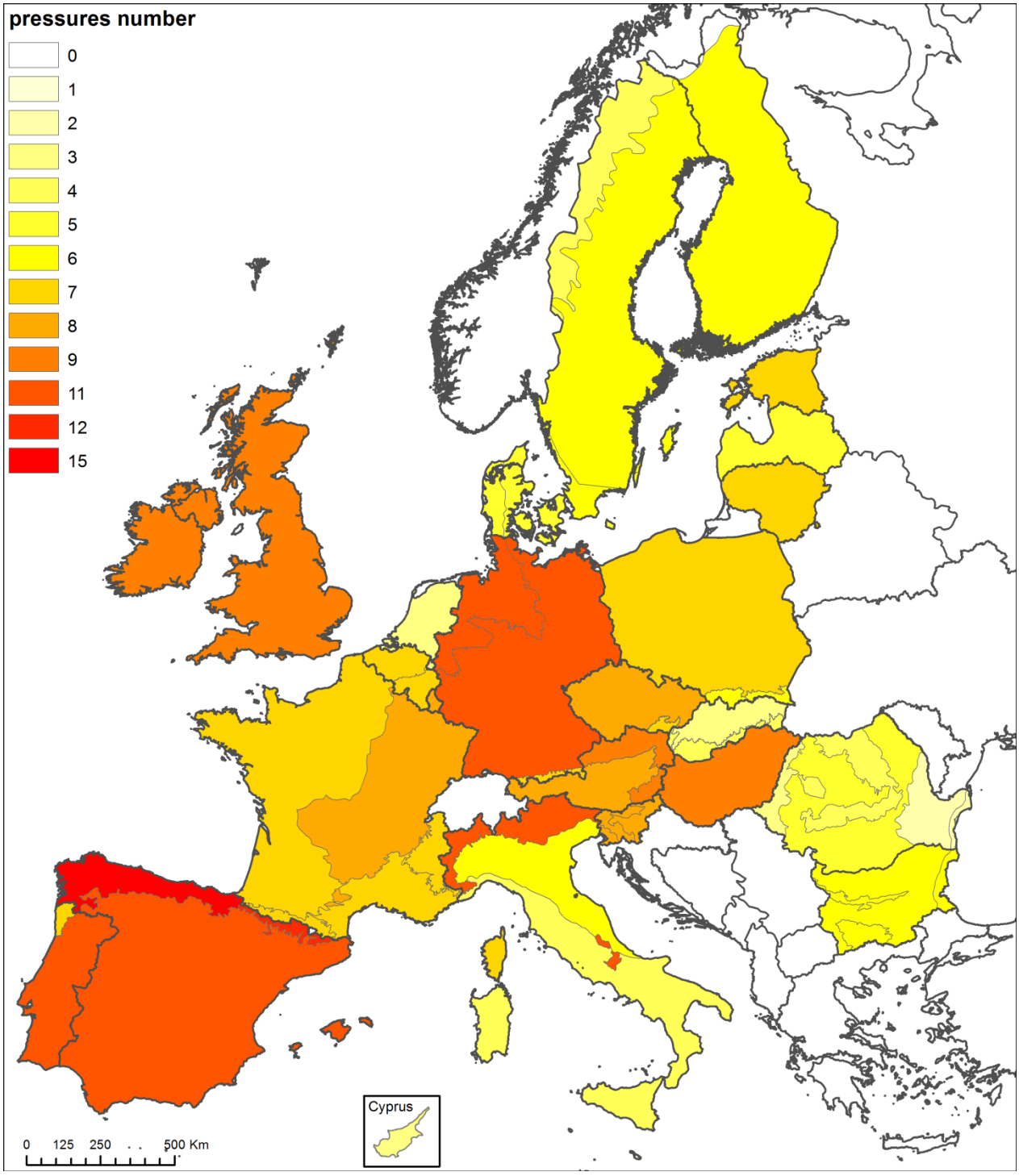
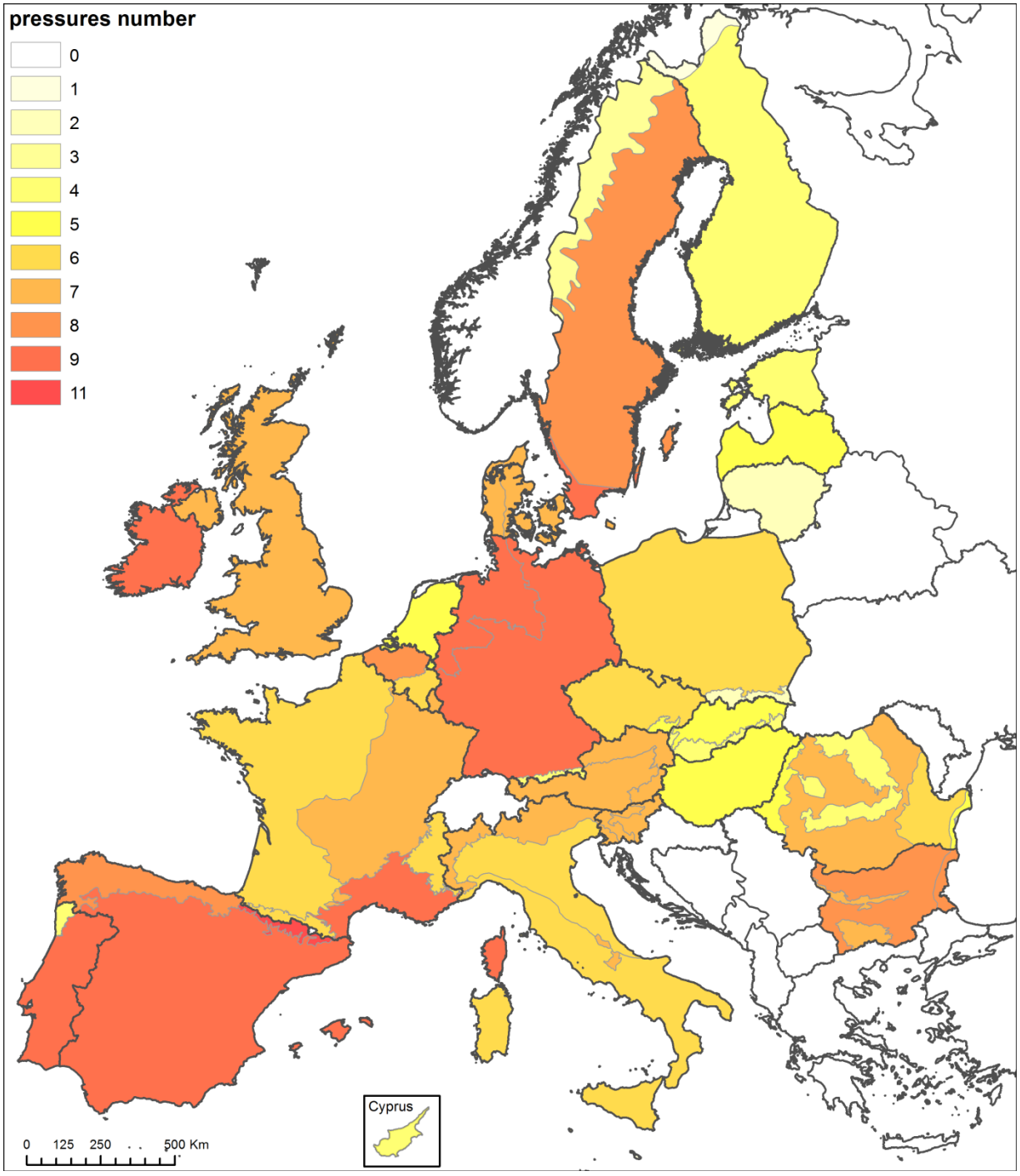


Fig. 3.10: **Number of agricultural pressures influencing habitats partly depending on agricultural practices** (40 habitat types)



D – Pressure index for agricultural pressures influencing habitats, depending on agricultural practices

Here we provide examples of maps showing pressure index related to agricultural pressures that influence habitats, depending on agricultural practices. The pressure index took into account the intensity of pressure reported by Member Countries and it was computed using following coefficients:

L (low intensity): coefficient 1

M (medium intensity): coefficient 2

H (high intensity): coefficient 3

We display only maps for agricultural pressures without dividing them to individual groups of pressures (intensification, abandonment, other agricultural pressures) and do not provide maps for non-agricultural pressures and all pressures. All these types of maps can be prepared if they are found useful.

Fig. 3.11: Pressure index for all habitats depending on agricultural practices (agricultural pressures only)

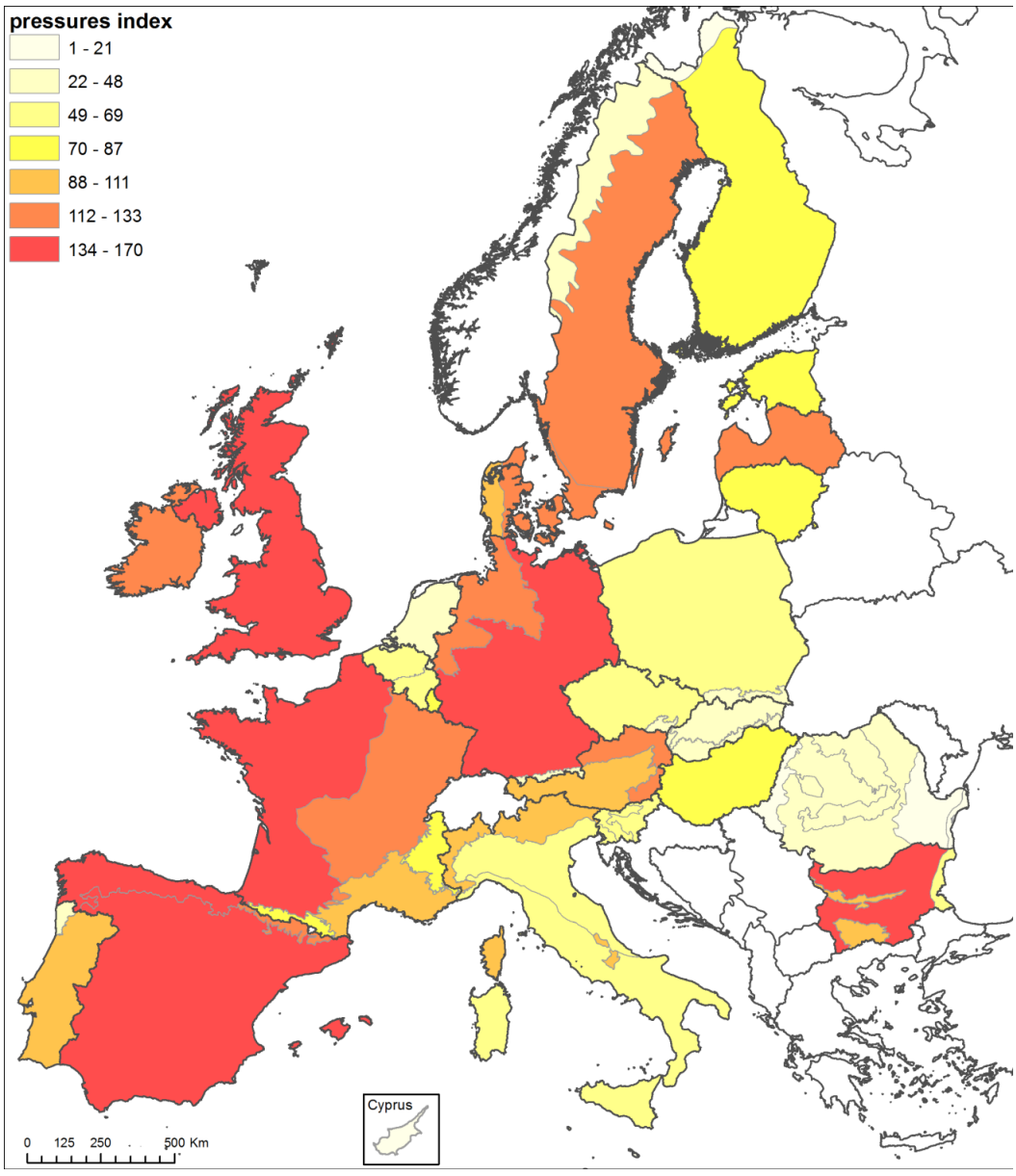


Fig. 3.12: **Pressure index for habitats fully depending on agricultural practices** (agricultural pressures only)

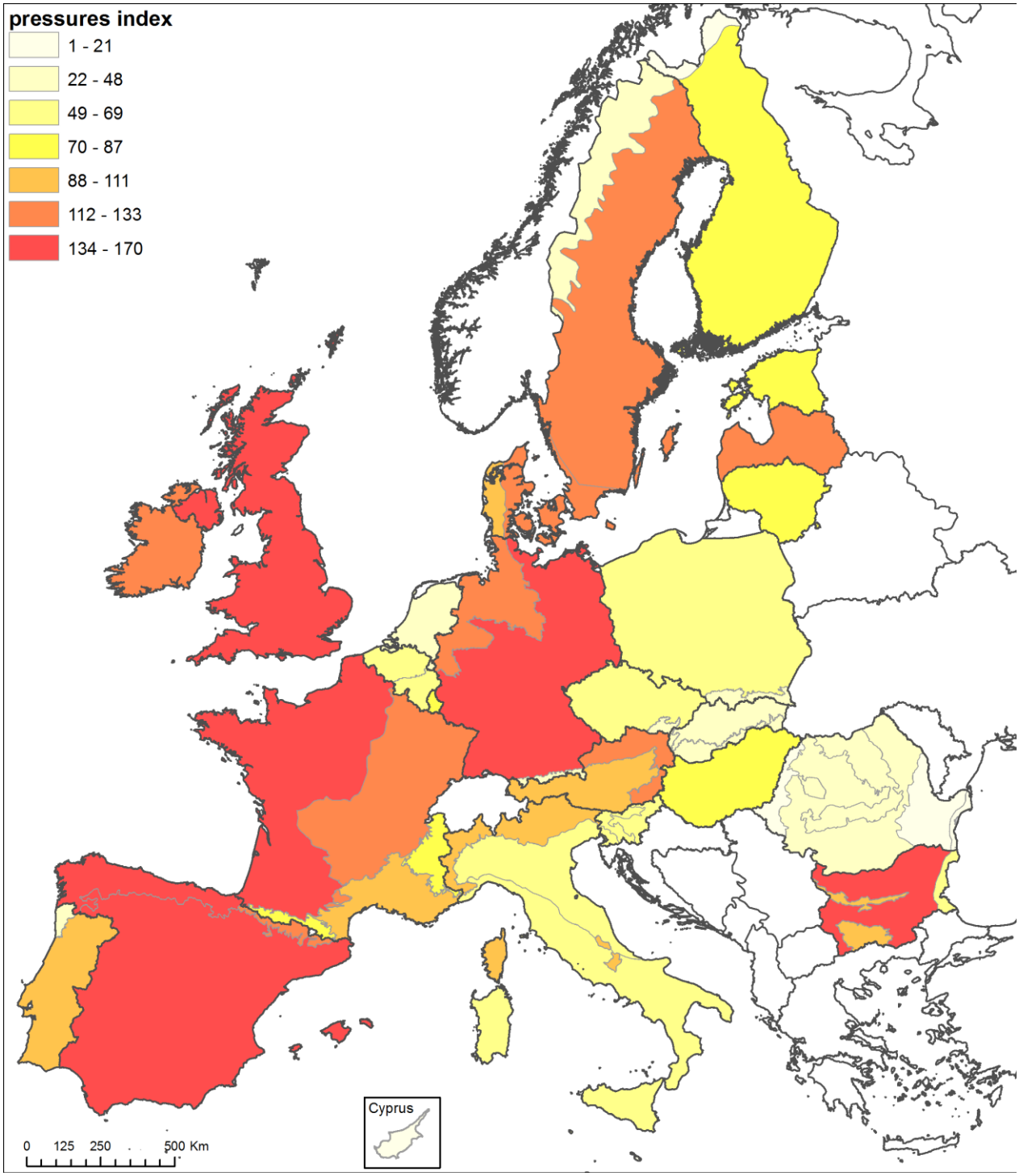
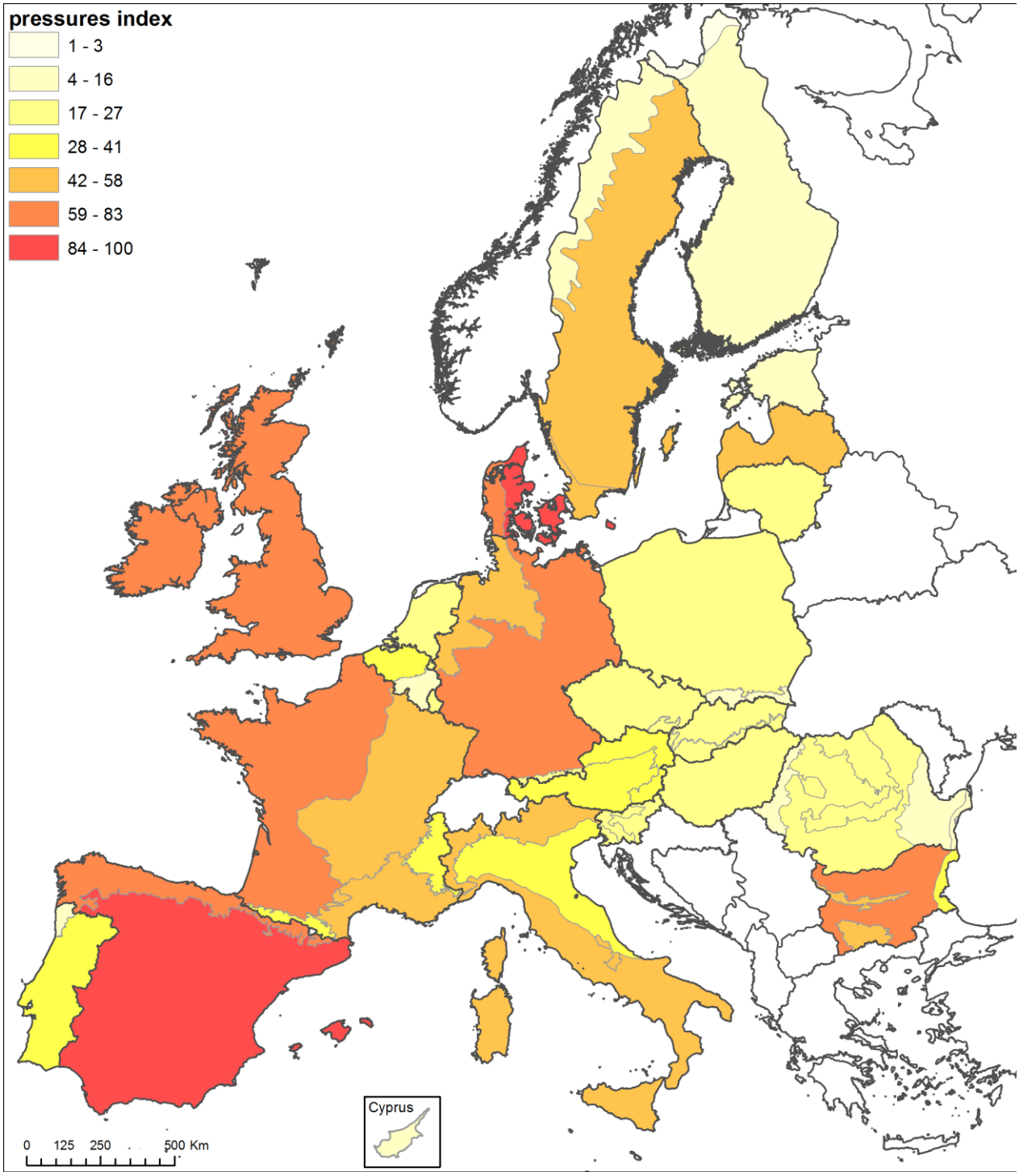


Fig. 3.13: **Pressure index for habitats partly depending on agricultural practices** (agricultural pressures only)



3.2 Maps for Article 17 distribution grid

The aim of this part of the report is to explore possibilities for downscaling of analysis from reporting units to grid of grid cell 10x10 km. The limitations and assumptions of this approach are discussed in chapter 2.4.

To analyze the number of pressures we have to deal with the fact that there could be reported more pressures to one habitat and there is different number of habitats in one Art 17 square. Therefore it was not possible to join the pressures table to Art 17 layer directly and summarize the results. We have to count separately number of habitats that are affected by specific pressure in each Art 17 square. This procedure takes these steps:

1. Export the habitats layer from Art17 database
2. Join the table containing the information about the distribution of specific pressure to the each habitat separately and calculate the pressures number and pressures index.
3. Summarize the number of pressures and pressures index of specific pressure for all habitats, habitats in group D (fully depending on agricultural practices), and habitats in group P (partly depending on agricultural practices).
4. Summarize all pressures together, in groups Ab (abandonment), I (Intensification) and U (other agricultural pressures). This needs to be done separately for habitats in group P, and habitats in group D

A python script was developed for this procedure. The script for analysis of one pressure is 322 lines long. The length of the script for the agricultural pressures is 9,321 lines long. Calculating of all pressures would take 84,292 lines. Developing, testing and debugging of the script took 7 days. The procedure is demanding for the computer power, only one group of pressures could be analyzed in one day. The post-processing (summarizing and map creation) will take another 1 - 2 days per pressure group. Therefore we would recommend to analyze only the agricultural pressures and to skip other pressures. In this stage the creating of all maps of agricultural pressures will take another 1 - 2 days. To analyze all the pressures would take at least additional 10 days.

E – Number of habitat types influenced by individual groups of pressures

EA - Number of all habitat types influenced by individual groups of pressures

The following maps show number of habitat types depending on agricultural practices (63 habitat types as identified in Halada et al., 2011) that are influenced by individual groups of pressures.

Fig. 3.14: Number of all habitats influenced by agricultural pressures (pressure code starting with "A")

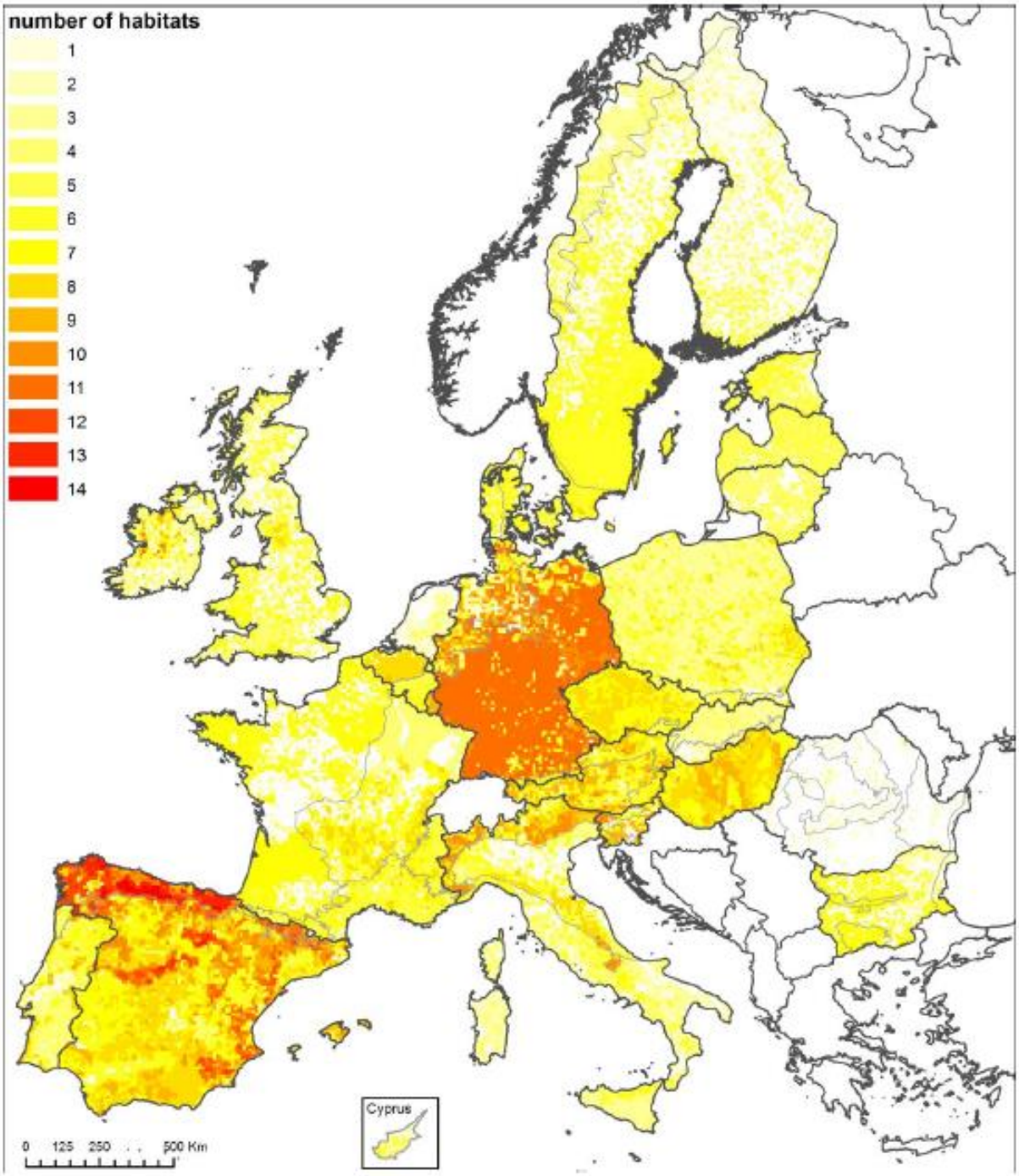


Fig. 3.15: Number of all habitats influenced by agriculture intensification (I)

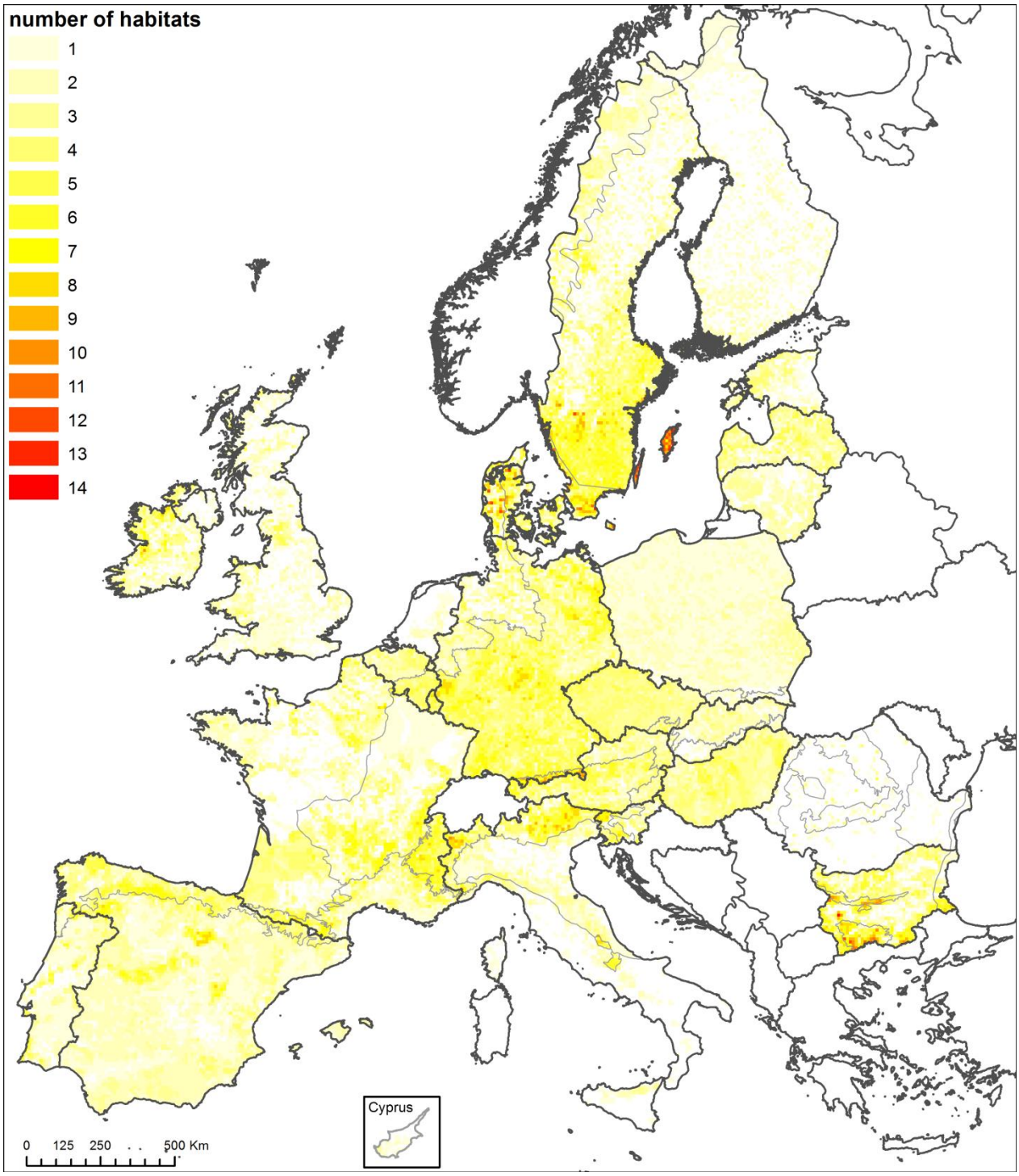
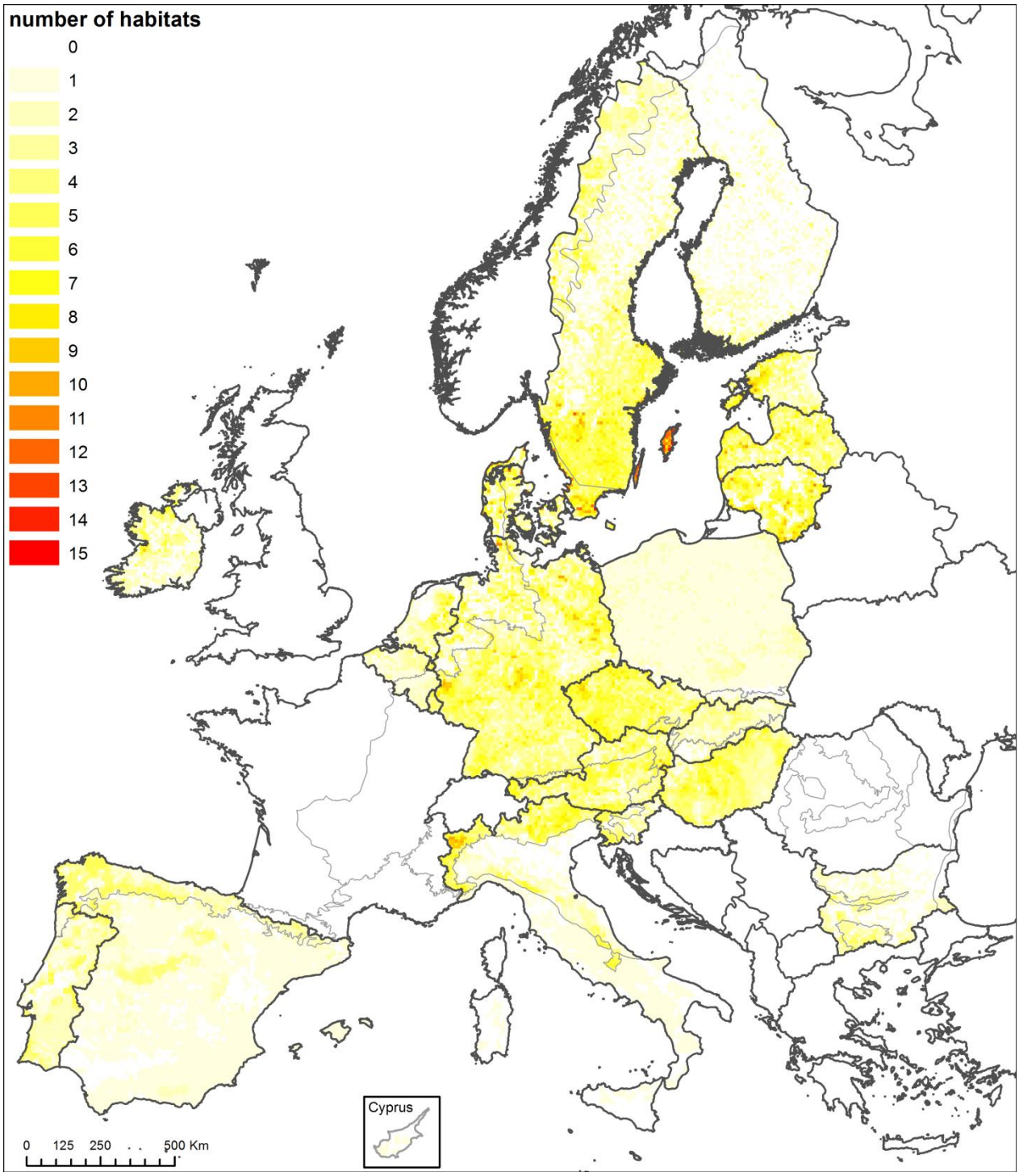
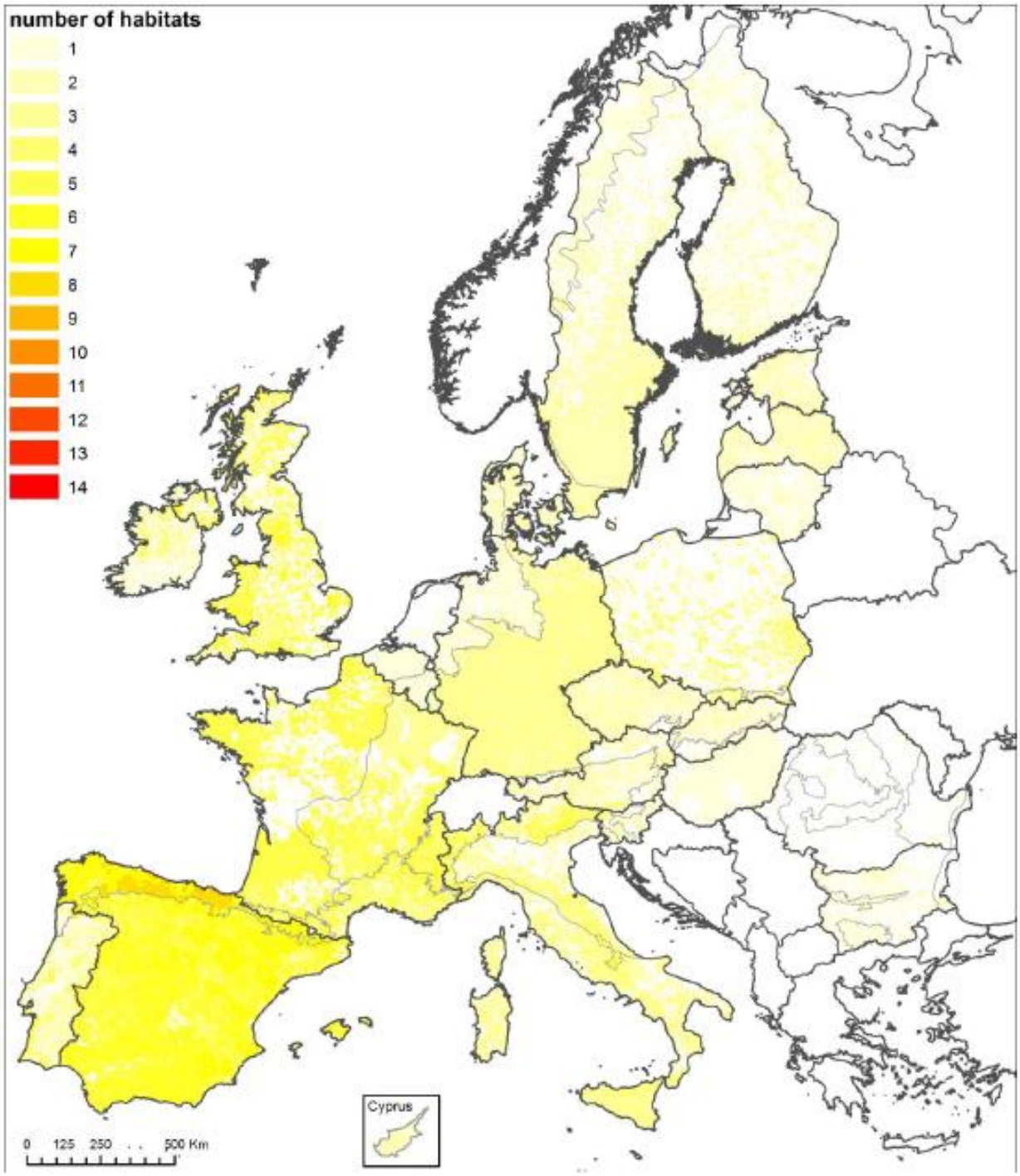


Fig. 3.16: Number of all habitats influenced by abandonment (Ab)



No Pressures reported at level 3 by FR, UK and RO explain they are in white (to be confirmed)

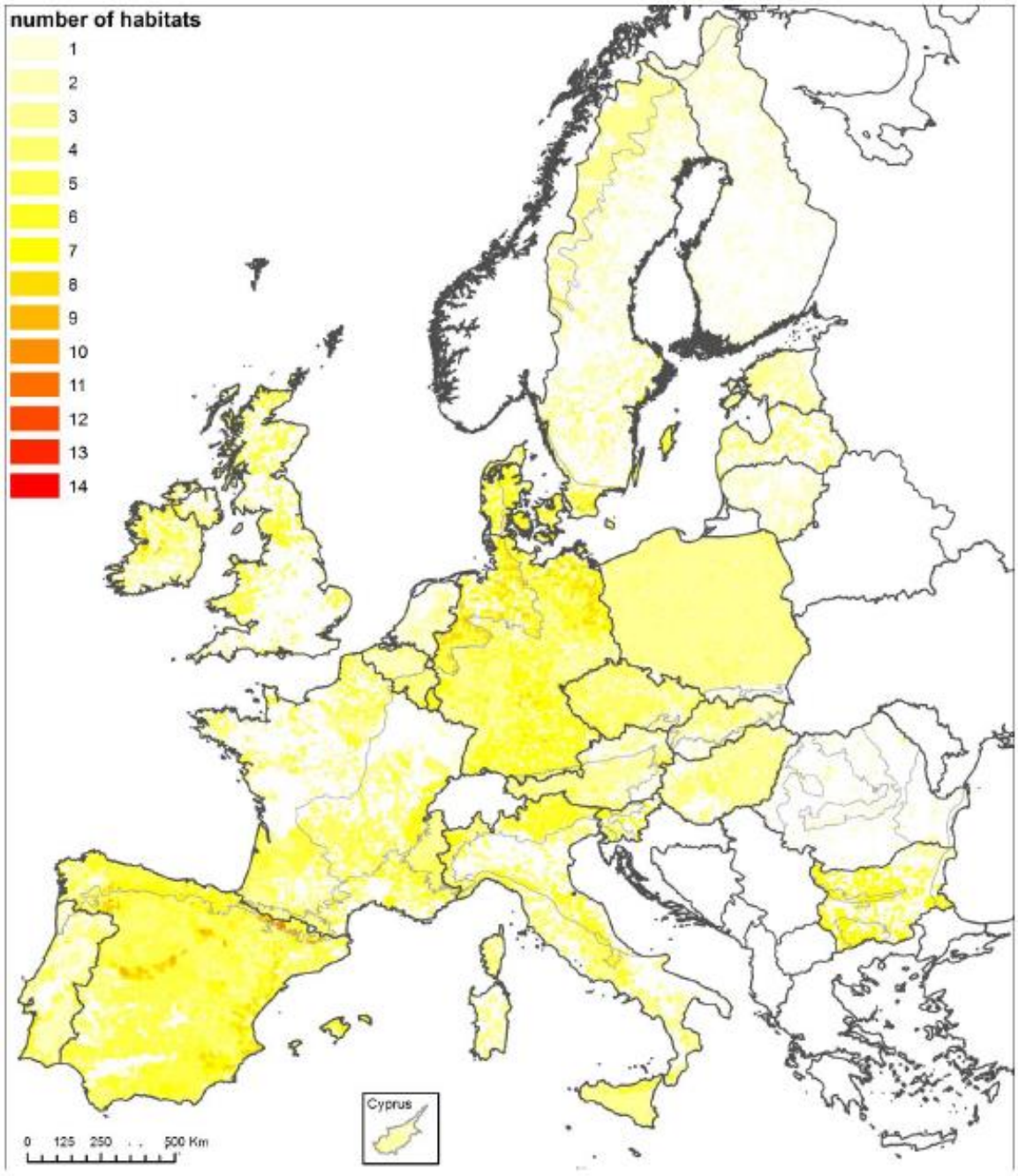
Fig. 3.17: Number of all habitats influenced by other agricultural pressures (U)



EB - Number of habitats types fully depending on agricultural practices that are influenced by individual groups of pressures

The following map show number of habitat types, **fully** depending on agricultural practices (23 habitat types as identified in Halada et al., 2011) that are influenced by agricultural pressures (pressure code starting with "A"). It is possible to prepare for this set of habitats all types of maps that were prepared for EA, but for demonstration purposes it is not necessary, therefore we present only map for agricultural pressures. The same approach we used in group DC below.

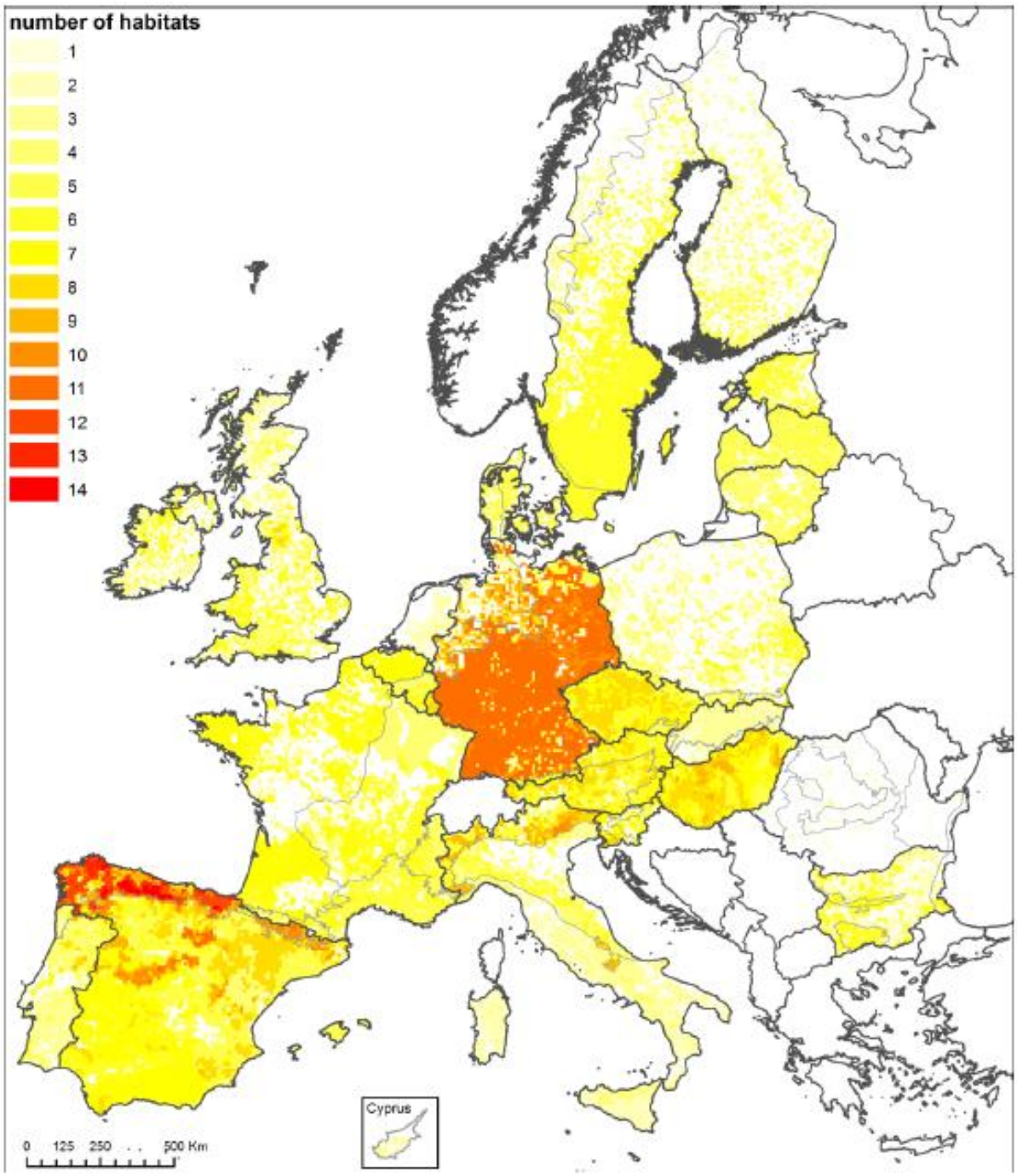
Fig. 3.18: Number of habitats types fully depending on agricultural practices influenced by agricultural pressures (pressure code starting with "A")



EC - Number of habitats types partly depending on agricultural practices that are influenced by individual groups of pressures

The following map show number of habitat types, **partly** depending on agricultural practices (40 habitat types as identified in Halada et al., 2011) that are influenced by agricultural pressures. We do not show here other maps prepared above for EA, but they could be prepared.

Fig. 3.19: Number of habitats types partly depending on agricultural practices influenced by agricultural pressures (pressure code starting with "A")



F – Number of pressures influencing habitats, depending on agricultural practices

Here we provide examples of maps showing number of agricultural pressures that influence habitats, depending on agricultural practices. We display only maps for agricultural pressures without dividing them to individual groups of pressures (intensification, abandonment, other agricultural pressures) and do not provide maps for non-agricultural pressures and all pressures. All these types of maps can be prepared if they are found to be useful.

Fig. 3.20: Number of agricultural pressures influencing all habitats depending on agricultural practices (63 habitat types)

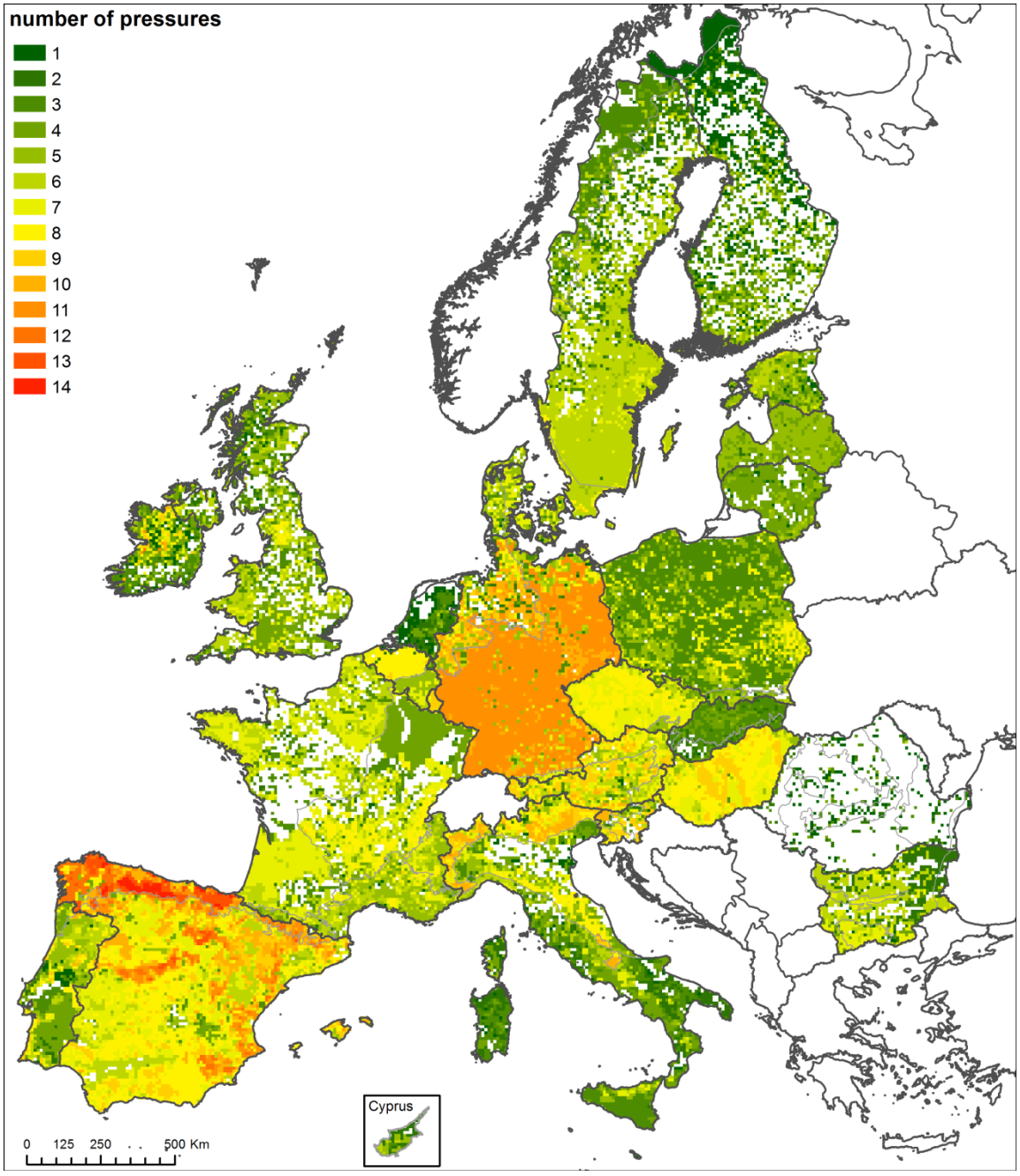


Fig. 3.21: **Number of agricultural pressures influencing habitats fully depending on agricultural practices** (23 habitat types)

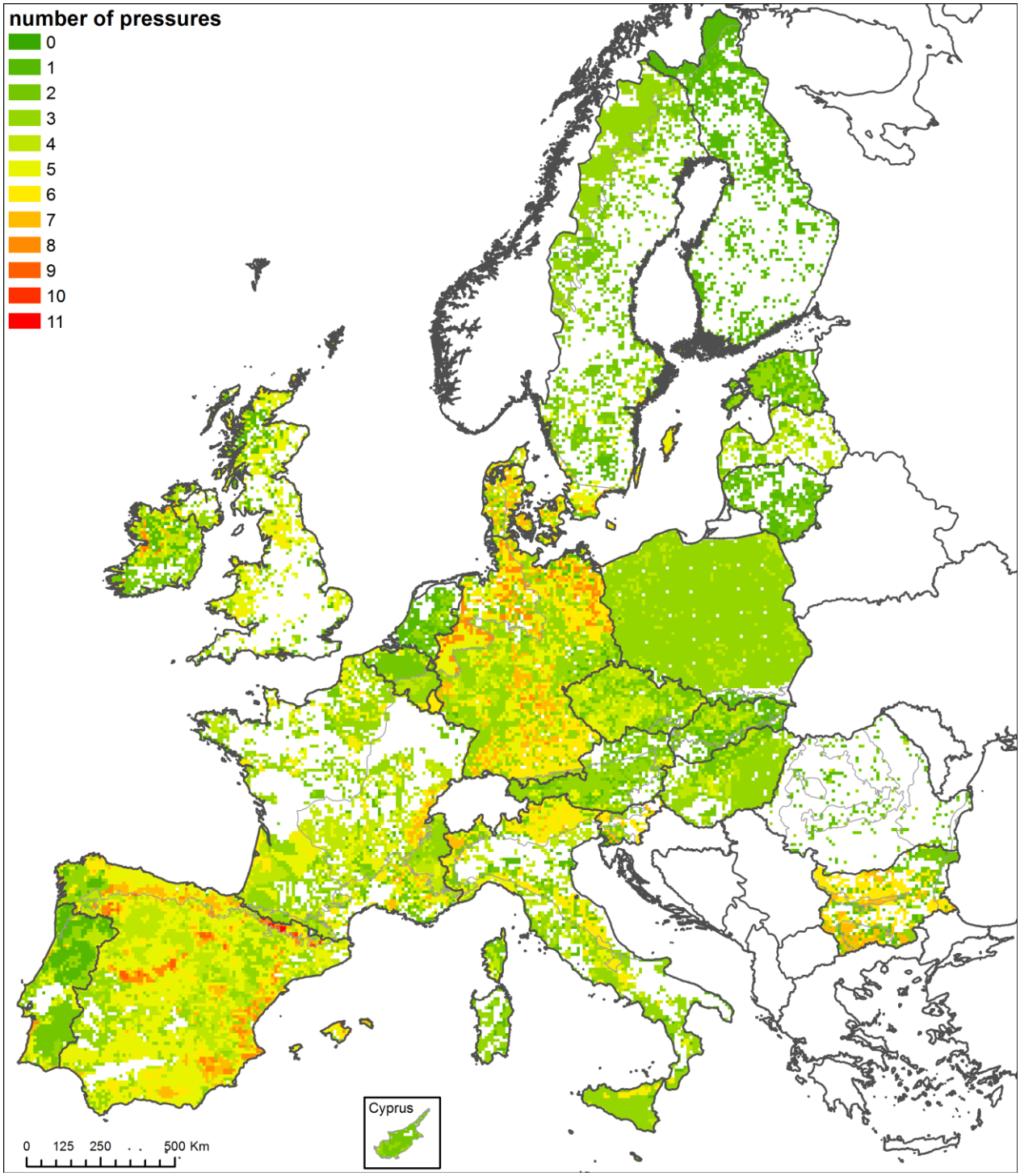
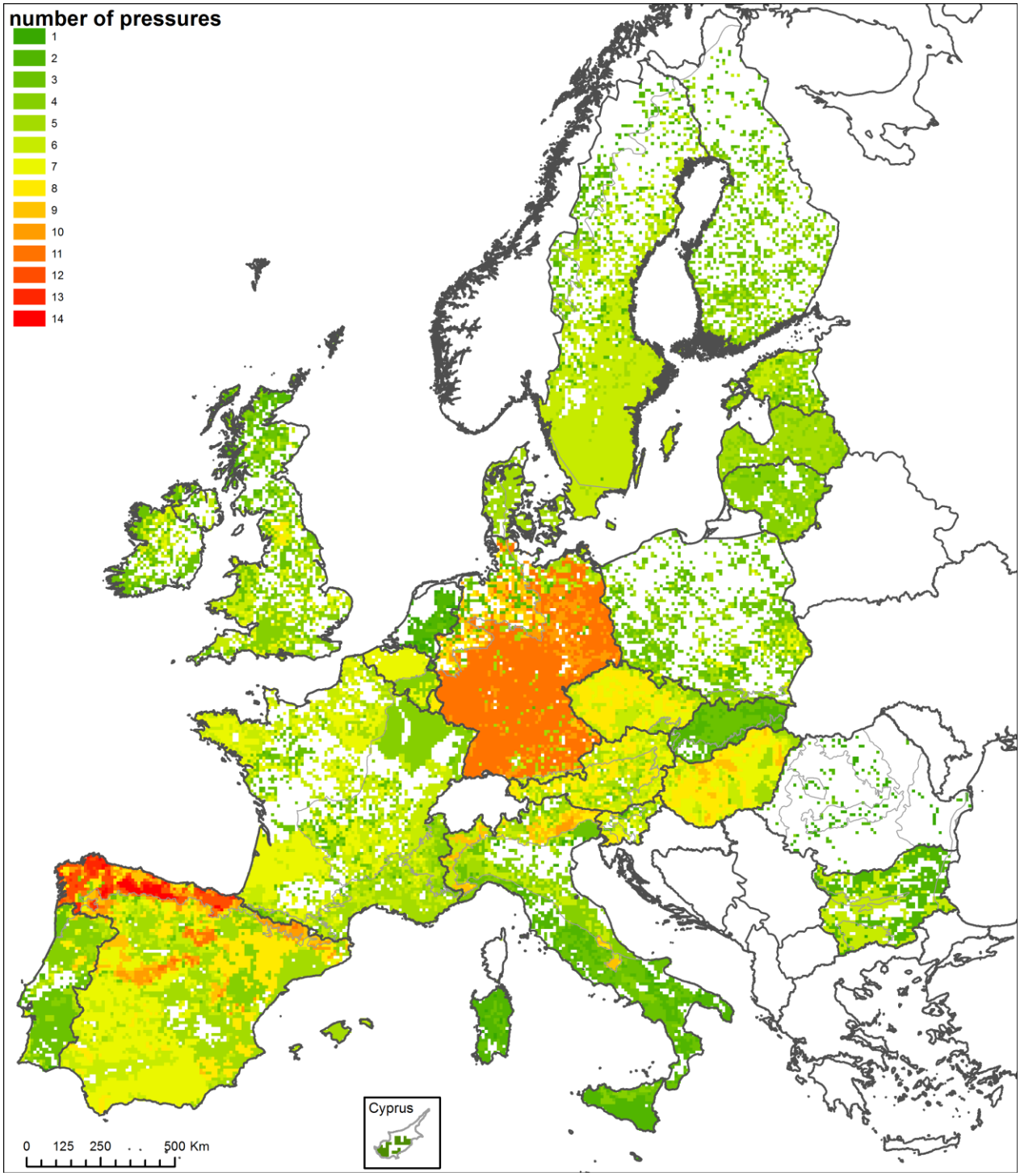


Fig. 3.22: **Number of agricultural pressures influencing habitats partly on agricultural practices** (40 habitat types)



G – Pressure index for agricultural pressures influencing habitats, depending on agricultural practices

Here we provide examples of maps showing pressure index related to agricultural pressures that influence habitats, depending on agricultural practices. The pressure index took into account the intensity of pressure reported by Member Countries and it was computed using following coefficients:

L (low intensity): coefficient 1

M (medium intensity): coefficient 2

H (high intensity): coefficient 3

We display only maps for agricultural pressures without dividing them to individual groups of pressures (intensification, abandonment, other agricultural pressures) and do not provide maps for non-agricultural pressures and all pressures. All these types of maps can be prepared if they are found useful.

Fig. 3.23 **Pressure index for all habitats depending on agricultural practices** (agricultural pressures only)

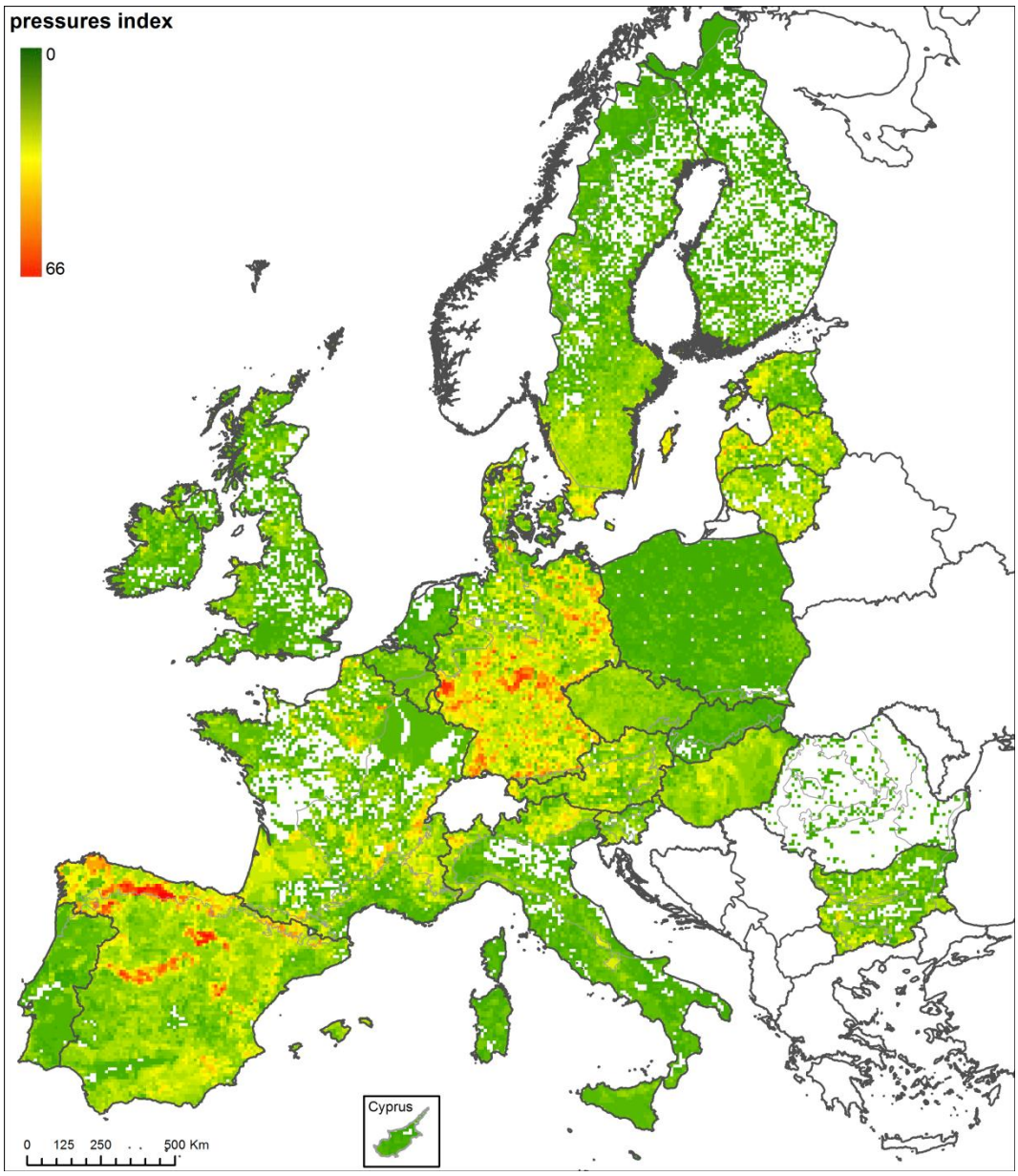


Fig. 3.24: **Pressure index for habitats fully depending on agricultural practices** (agricultural pressures only)

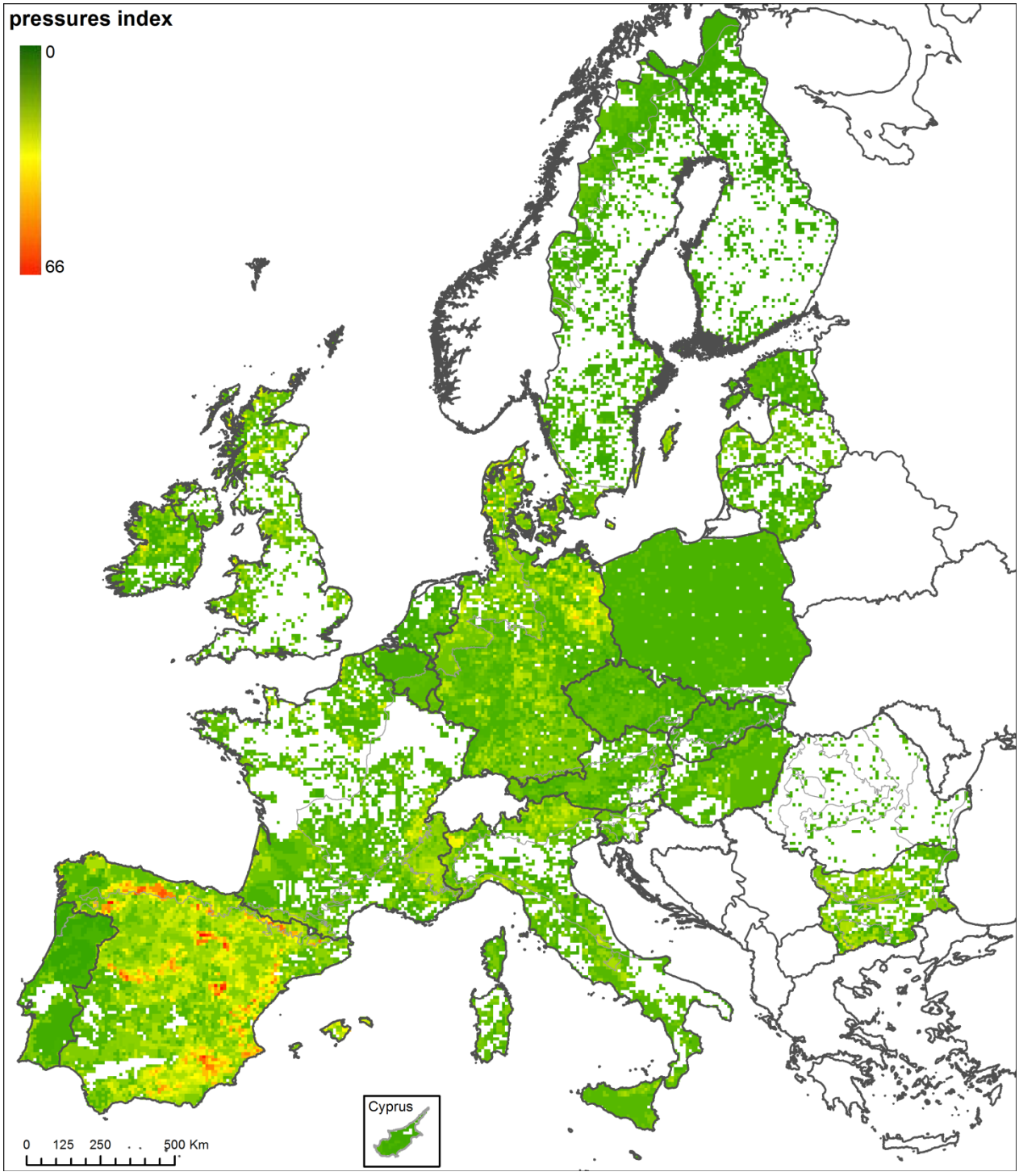
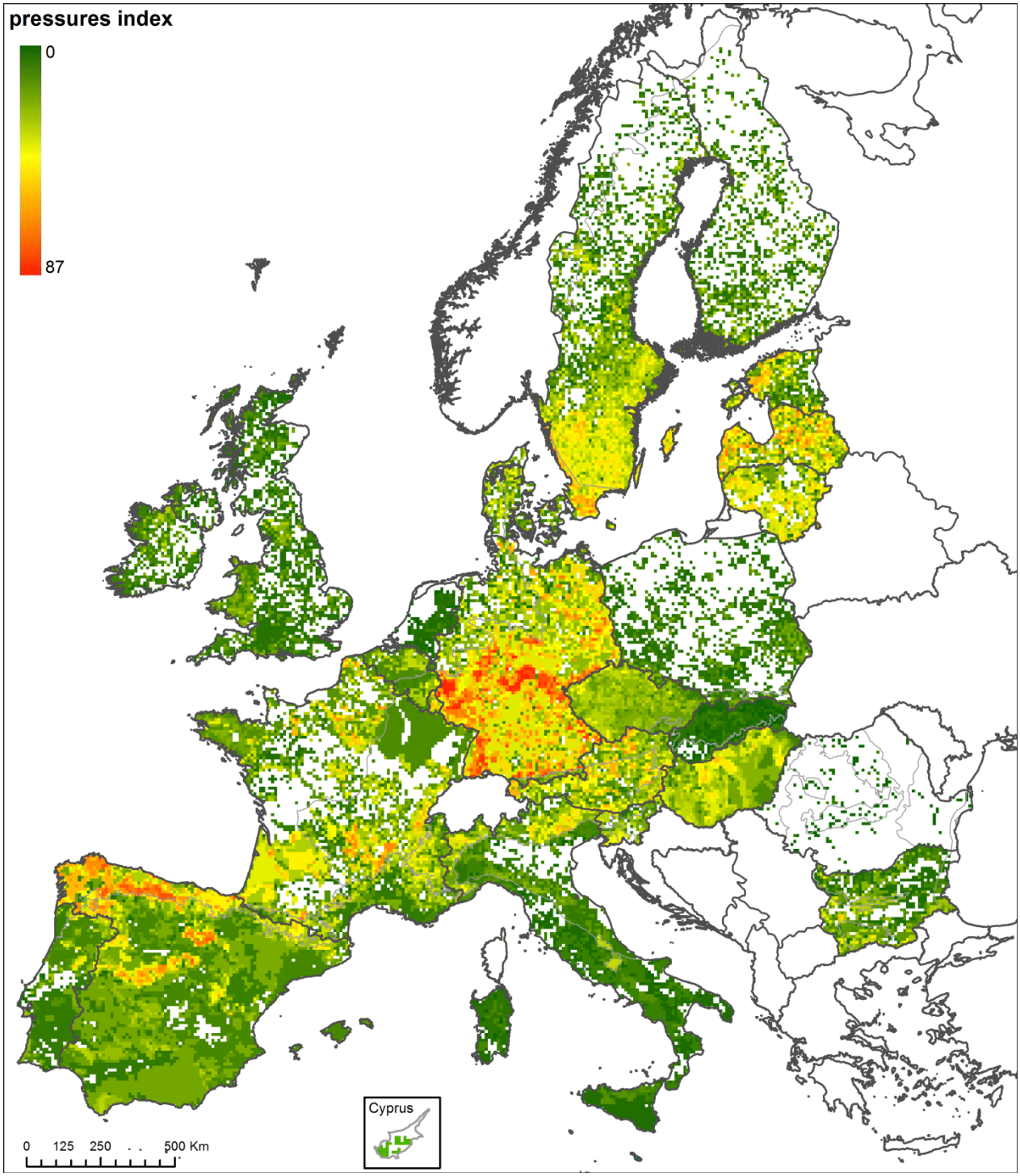


Fig. 3.25: **Pressure index for habitats partly depending on agricultural practices** (agricultural pressures only)



4 Conclusions

In this document, we provided results of exploration of possibilities to map pressures to habitats of the European importance that depend on agricultural practices. When preparing the analysis, we needed to take some decisions that influenced the methods adopted and also results. All these decisions should be further discussed and options to be used for the future work should be recommended. We briefly summarize below main points to be discussed.

Hierarchical level of pressures to be used. The decision on hierarchical level of pressures that should be taken as a basis for analysis can influence crucially results of analysis. We discussed three options in chapter 2.2 and provided brief information about advantages and limitations of individual options. We consider important to provide clear recommendation or decision in this issue.

Groups of species and habitat types that should be subject of assessment are discussed in chapter 2.3. Here is quite clear vision which species and which habitats should be included to the future analysis. Probably the only open question is if to include to analysis focused to grasslands (second type in chapter 2.3) also a few grassland habitat types that do not depend on agricultural management.

This analysis was focused to groups of habitats. The usefulness of preparation of pressures map for individual habitat types and individual species should be examined and decision in this issue needs to be taken.

The way of pressures quantification should be further discussed. We proposed some possibilities in chapter 2.5 and the decision should be taken especially about use of coefficients.

In chapter 3.2 we tested spatial extrapolation from reporting units (biogeographical region inside country) to grid maps of grid size 10x10 m. This extrapolation needs some assumptions, namely considering pressures to be operating in whole reporting unit with the same intensity and thus results can say something about potential location of pressures (see also chapter 2.4). Having in mind these assumptions and limitations of this approach, it should be discussed if they are not too big and if this approach should be used. If it will be decided to adopt it, then it is also necessary to discus question how to communicate results of this approach to avoid misunderstanding.

Finally, it should be mentioned that mapping of pressures is quite time-consuming work. Therefore, very clear decisions need to be taken that will guide the future work to use resources efficiently and to provide useful products. We found that some analyses are exceptionally time-consuming and/or demanding high computational power. Also this aspect should be taken into account when the future work in this field is discussed.

5 References

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6 Annexes

Annex 1: List of habitat species depending on agricultural practices (Halada et al., 2011)

Code	Habitat name	D	P	M
1330	Atlantic salt meadows (Glauco-Puccinellietalia maritimae)		1	1
1340	Inland salt meadows		1	
1530	Pannonic salt steppes and salt marshes		1	1
1630	Boreal Baltic coastal meadows		1	
2130	Fixed coastal dunes with herbaceous vegetation (grey dunes)		1	1
2140	Decalcified fixed dunes with *Empetrum nigrum*		1	1
2150	Atlantic decalcified fixed dunes (*Calluno-Ulicetea*)		1	1
2160	Dunes with Hippophaë rhamnoides		1	1
2170	Dunes with Salix repens ssp. argentea (Salicion arenariae)		1	1
2190	Humid dune slacks		1	
21A0	Machairs	1		
2250	Coastal dunes with Juniperus spp.		1	
2310	Dry sandy heaths with *Calluna* and *Genista*		1	1
2320	Dry sandy heaths with *Calluna* and *Empetrum nigrum*		1	1
2330	Inland dunes with open *Corynephorus* and *Agrostis* grasslands		1	1
2340	Pannonic inland dunes	1		
4010	Northern Atlantic wet heaths with *Erica tetralix*	1		
4020	Temperate Atlantic wet heaths with *Erica ciliaris* and *Erica tetralix*	1		
4030	European dry heaths	1		
4040	Dry Atlantic coastal heaths with *Erica vegans*	1		
4060	Alpine and Boreal heaths		1	1
4090	Endemic oro-Mediterranean heaths with gorse		1	
5120	Mountain *Cytisus purgans* formations		1	1
5130	*Juniperus communis* formations on heaths or calcareous grasslands		1	
5210	Arborescent matorral with J*uniperus* spp.		1	1
5330	Thermo-Mediterranean and pre-desert scrub		1	1
5420	Sarcopoterium spinosum phryganas		1	
5430	Endemic phryganas of the Euphorbio-Verbascion		1	
6110	Rupicolous calcareous or basophilic grasslands of the *Alysso-Sedion albi*		1	1
6120	Xeric sand calcareous grasslands		1	
6140	Siliceous Pyrenean *Festuca eskia* grasslands		1	
6150	Siliceous alpine and boreal grasslands		1	

Code	Habitat name	D	P	M
6160	Oro-Iberian Festuca indigesta grasslands		1	
6170	Alpine and subalpine calcareous grasslands		1	
6180	Macaronesian mesophile grasslands		1	
6190	Rupicolous pannonic grasslands (*Stipo-Festucetalia pallentis*)	1		
6210	Semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco Brometalia*)	1		
6220	Pseudo-steppe with grasses and annuals of the *Thero-Brachypodietea*	1		
6230	Species-rich *Nardus* grasslands, on siliceous substrates in mountain areas (and sub-mountain areas, in continental Europe)	1		
6240	Sub-pannonic steppic grassland		1	
6250	Pannonic loess steppic grasslands	1		
6260	Pannonic sand steppes	1		
6270	Fennoscandian lowland species-rich dry to mesic grasslands	1		
6280	Nordic alvar and precambrian calcareous flatrocks	1		
62A0	Eastern sub-Mediterranean dry grasslands (*Scorzoneratalia villosae*)	1		
62C0	Ponto-Sarmatic steppes		1	1
62D0	Oro-Moesian acidophilous grasslands		1	1
6310	Dehesas with evergreen *Quercus* spp.	1		
6410	*Molinia* meadows on calcareous, peaty or clayey-silt-laden soils (*Molinion caeruleae*)	1		
6420	Mediterranean tall humid herb grasslands of the *Molinio-Holoschoenion*		1	
6430	Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels		1	1
6440	Alluvial meadows of river valleys of the *Cnidion dubii*	1		
6450	Northern boreal alluvial meadows	1		
6510	Lowland hay meadows (Alopecurus pratensis, Sanguisorba officinalis)	1		
6520	Mountain hay meadows	1		
6530	Fennoscandian wooded meadows	1		
7140	Transition mires and quaking bogs		1	1
7150	Depressions on peat substrates of the Rhynchosporion		1	1
7210	Calcareous fens with Cladium mariscus and species of the Caricion davallianae		1	1
7230	Alkaline fens		1	
8230	Siliceous rock with pioneer vegetation of the *Sedo-Scleranthion* or of the *Sedo albi-Veronicion dillenii*		1	1
8240	Limestone pavements		1	
9070	Fennoscandian wooded pastures	1		

Legend. **D** - habitat type fully dependent on agricultural management; **P** - habitat partially dependent (usually agricultural management blocks secondary succession); **M** - relationship with extensive farming practices holds true for only some sub-types or for part of their distribution

Annex 2: Species of the Habitats directive linked to agricultural habitats*

Molluscs	Arthropods	Reptiles
Caseolus calculus	Lycaena helle	Elaphe longissima
Caseolus commixta	Maculinea arion	Elaphe quatuorlineata
Discula leacockiana	Maculinea nausithous	Elaphe situla
Discula turricula	Maculinea teleius	Eryx jaculus
Helicopsis striata austriaca	Melanargia arge	Lacerta agilis
Helix pomatia	Odontopodisma rubripes	Lacerta bonnali (L. monticola)
Idiomela (Helix) subplicata	Paracaloptenus caloptenoides	Lacerta schreiberi
Vertigo angustior	Parnassius apollo	Lacerta viridis
Vertigo geyeri	Parnassius mnemosyne	Macrovipera schweizeri
Vertigo moulinsiana	Pholidoptera transsylvanica	Ophisops elegans
Arthropods	Phyllometra culminaria	Podarcis filfolensis
Agriades glandon aquilo	Pilemia tigrina	Podarcis milensis
Baetica ustulata	Plebicula golgus	Podarcis muralis
Bolbelasmus unicornis	Polymixis rufocincta isolata	Podarcis taurica
Carabus hungaricus	Polyommatus eroides	Testudo graeca
Carabus zawadszkii	Probaticus subrugosus	Testudo hermanni
Catopta thrips	Proserpinus proserpina	Vipera ursinii
Chondrosoma fiduciarium	Pseudophilotes bavius	Vipera ursinii rakosiensis
Clossiana improba	Saga pedo	Vipera xanthina
Coenonympha hero	Stenobothrus eurasius	**Mammals**
Coenonympha oedippus	Zerynthia polyxena	Bison bonasus
Colias myrmidone	**Amphibians**	Capra ibex
Cucullia mixta	Bufo calamita	Capra pyrenaica pyrenaica
Dorcadion fulvum cervae	Bufo viridis	Cervus elaphus corsicanus
Erebia calcaria	Pelobates fuscus	Cricetus cricetus
Erebia christi	Pelobates fuscus insubricus	Gulo gulo
Erebia medusa polaris	Pelobates syriacus	Herpestes ichneumon
Erebia sudetica	Salamandra atra	Lepus timidus
Eriogaster catax	Salamandra aurorae	Marmota marmota latirostris
Euphydryas aurinia	Salamandra lanzai	Mesocricetus newtoni
Glyphipterix loricatella	**Reptiles**	Microtus cabrerae
Gortyna borelii lunata	Ablepharus kitaibelii	Microtus oeconomus arenicola
Hesperia comma catena	Chalcides bedriagai	Microtus oeconomus mehelyi
Hyles hippophaes	Chalcides sexlineatus	Miniopterus schreibersii

Isophya costata	Chamaeleo chamaeleon	Mustela eversmanii
Isophya harzi	Coluber caspius	Mustela putorius
Isophya stysi	Coluber cypriensis	Myotis blythii
Lignyoptera fumidaria	Coluber jugularis	Myotis emarginatus
Lycaena dispar	Coluber najadum	Myotis myotis

Annex 2 - continues

Mammals	Plants	Plants
Rhinolophus ferrumequinum	Bromus grossus	Euphrasia azorica
Rhinolophus hipposideros	Bunium brevifolium	Euphrasia genargentea
Rhinolophus mehelyi	Campanula bohemica	Echium russicum
Rupicapra pyrenaica ornata	Campanula gelida	Eryngium alpinum
Rupicapra rupicapra	Campanula romanica	Erysimum pieninicum
Rupicapra rupicapra balcanica	Campanula serrata	Euphorbia nevadensis
Rupicapra rupicapra tatrica	Carduus myriacanthus	Euphrasia grandiflora
Sicista subtilis	Carlina onopordifolia	Euphrasia mendoncae
Spermophilus citellus	Centaurea jankae	Ferula sadleriana
Spermophilus suslicus	Centaurea lactiflora	Festuca brigantina
Vormela peregusna	Centaurea micrantha herminii	Festuca duriotagana
Plants	Centaurea rothmalerana	Festuca elegans
Aconitum corsicum	Centaurium rigualii	Festuca henriquesii
Adenophora lilifolia	Cerastium alsinifolium	Festuca summilusitana
Adonis distorta	Chaenorrhinum serpyllifolium ssp. lusitanicum	Fritillaria drenovskii
Agrimonia pilosa	Chaerophyllum azoricum	Galanthus nivalis
Ammi trifoliatum	Cirsium brachycephalum	Galium cracoviense
Androcymbium europaeum	Colchicum arenarium	Galium moldavicum
Angelica palustris	Colchicum corsicum	Galium sudeticum
Anthyllis lemanniana	Colchicum cousturieri	Gentiana ligustica
Aquilegia alpina	Corydalis gotlandica	Gentiana lutea
Armeria sampaio	Crambe tataria	Gentianella anglica
Arnica montana	Cypripedium calceolus	Gentianella bohemica
Artemisia eriantha	Dactylorhiza kalopissii	Gladiolus palustris
Artemisia granatensis	Daphne arbuscula	Gymnigritella runei
Artemisia laciniata	Deschampsia maderensis	Gypsophila papillosa
Artemisia oelandica	Dianthus arenarius arenarius	Herniaria algarvica
Artemisia pancicii	Dianthus arenarius bohemicus	Herniaria maritima

Aster pyrenaeus	Dianthus diutinus	Himantoglossum adriaticum
Aster sorrentinii	Dianthus lumnitzeri	Himantoglossum caprinum
Astragalus aquilanus	Dianthus marizii	Hladnikia pastinacifolia
Astragalus centralpinus	Dianthus moravicus	Holcus setiglumis ssp. duriensis
Astragalus maritimus	Dianthus nitidus	Hyacinthoides vicentina
Astragalus peterfii	Dianthus plumarius regis-stephani	Iris aphylla ssp. hungarica
Astragalus tremolsianus	Diplotaxis ibicensis	Iris boissieri
Astragalus verrucosus	Diplotaxis siettiana	Iris humilis ssp. arenaria
Biscutella neustriaca	Dorycnium pentaphyllum ssp. transmontana	Iris lusitanica
Botrychium simplex	Dracocephalum austriacum	Iris marisca

Annex 2 - continues

Plants	Plants	Plants
Jonopsidium acaule	Onosma tornensis	Saxifraga osloënsis
Jonopsidium savianum	Ophrys argolica	Saxifraga valdensis
Jurinea cyanoides	Ophrys kotschyi	Scabiosa nitens
Lactuca watsoniana	Ophrys lunulata	Scilla beirana
Lamyropsis microcephala	Ophrys melitensis	Scilla litardierei
Leontodon microcephalus	Orchis scopulorum	Scrophularia grandiflora ssp. grandiflora
Leontodon siculus	Ornithogalum reverchonii	Scrophularia hermini
Leucojum nicaeense	Paeonia officinalis ssp. banatica	Senecio elodes
Ligularia sibirica	Paeonia parnassica	Senecio jacobea ssp. gotlandicus
Linaria pseudolaxiflora	Picris willkommii	Senecio lagascanus lusitanicus
Linaria ricardoi	Pinguicula nevadensis	Serratula lycopifolia
Linum dolomiticum	Platanthera obtusata oligantha	Seseli leucospermum
Lotus azoricus	Potentilla delphinensis	Sorbus teodorii
Lythrum flexuosum	Potentilla emilii-popii	Spiranthes aestivalis
Minuartia smejkalii	Primula nutans	Stipa austroitalica
Moehringia jankae	Primula scandinavica	Stipa bavarica
Muscari gussonei	Puccinellia phryganodes	Stipa danubialis
Narcissus asturiensis	Puccinellia pungens	Stipa styriaca
Narcissus bulbocodium	Pulsatilla grandis	Stipa zalesskii
Narcissus cyclamineus	Pulsatilla patens	Tephroseris longifolia moravica
Narcissus fernandesii	Pulsatilla pratensis ssp. hungarica	Thesium ebracteatum
Narcissus juncifolius	Pulsatilla slavica	Thlaspi jankae
Narcissus nevadensis	Pulsatilla subslavica	Thymus capitellatus
Narcissus pseudonarcissus ssp. nobilis	Ranunculus weyleri	Thymus carnosus
Narcissus triandrus	Rumex azoricus	Tulipa hungarica
Narcissus triandrus ssp. capax	Santolina impressa	Vicia bifoliolata
Narcissus viridiflorus	Santolina semidentata	Vincetoxicum pannonicum
Nothothylas orbicularis	Saussurea alpina ssp. esthonica	Viola athois
Ononis hackelii	Saxifraga cintrana	

*Extracted from Roscher et al. (2015).

Annex 3: The bird species selected to the farmland bird indicator

Alauda arvensis	*Falco tinnunculus*	*Perdix perdix*
Alectoris rufa	*Galerida cristata*	*Petronia petronia*
Anthus campestris	*Galerida theklae*	*Saxicola rubetra*
Anthus pratensis	*Hirundo rustica*	*Saxicola torquatus*
Burhinus oedicnemus	*Lanius collurio*	*Serinus serinus*
Calandrella brachydactyla	*Lanius minor*	*Streptopelia turtur*
Carduelis cannabina	*Lanius senator*	*Sturnus unicolor*
Ciconia ciconia	*Limosa limosa*	*Sturnus vulgaris*
Corvus frugilegus	*Melanocorypha calandra*	*Sylvia communis*
Emberiza cirlus	*Miliaria calandra*	*Upupa epops*
Emberiza citrinella	*Motacilla flava*	*Vanellus vanellus*
Emberiza hortulana	*Oenanthe hispanica*	
Emberiza melanocephala	*Passer montanus*	