SUPPORT TO EUNIS HABITAT CLASSIFICATION REVISION IV

Joop H.J. Schaminée
Milan Chytrý
Stephan M. Hennekens
John A.M. Janssen
Ilona Knollová
Corrado Marcenò
Lubomír Tichý
and data providers

Reference: 3417/B2019/EEA6 Framework Contract: EEA/NSS/17/002/Lot 1

Wageningen Environmental Research (WENR, Alterra), Institute within the legal entity Stichting Dienst Landbouwkundig Onderzoek

Professor Joop H.J. Schaminée
Stephan M. Hennekens
Doctor John A.M. Janssen

Partners

Professor Milan Chytrý, Masaryk University, Brno, Czech Republic
Doctor Ilona Knollová, Masaryk University, Brno, Czech Republic
Doctor Corrado Marcenò, Masaryk University, Brno, Czech Republic
Associate Professor Lubomír Tichý, Masaryk University, Brno, Czech Republic

MUNI

Date: 07 April 2021

Wageningen Environmental Research (WENR)

P.O. Box 47
6700 AA Wageningen (NL)
Telephone: +31-317480700

In 2003 Alterra implemented a certified quality management system, according to the standard ISO 9001:2008.

Since 2006 Alterra works with a certified environmental care system according to the standard ISO 14001: 2004.

TABLE OF CONTENTS

Appendix A: List of the revised EUNIS Habitat Classification for Saltmarshes and Inland habitats with no or little soil and mostly with sparse vegetation, including an indication of the availability of a distribution map and a EUNIS-syntaxon crosswalk

Appendix B: Descriptions of the revised EUNIS Habitat Classification for Saltmarshes

Appendix C: Crosswalk between the revised EUNIS Habitat Classification for Saltmarshes and Inland habitats with no or little soil and mostly with sparse vegetation and *EuroVegChecklist* 2016

Appendix D: Formal definitions of the revised EUNIS Habitat Classification for Saltmarshes and Inland habitats with no or little soil and mostly with sparse vegetation (**only as an electronic appendix**)

Appendix E: Characteristic species combinations of the revised EUNIS Habitat Classification for Saltmarshes and Inland habitats with no or little soil and mostly with sparse vegetation

Appendix F: List of databases and data providers

Appendix G: Spreadsheet, with qualifiers, showing links between revised EUNIS Habitat Classification for Inland habitats with no or little soil and mostly with sparse vegetation and the Red list habitat types (**only as an electronic appendix**)

Appendix H: Spreadsheet, with qualifiers, aligning crosswalks of Red List terrestrial habitats to Annex I habitats (**only as an electronic appendix**)

1 Introduction

1.1 The context of the Specific Contract

To underpin the EU2020 Biodiversity Strategy adopted in 2011, the European Council has committed itself to a long-term vision and headline target. Recently, it therefore adopted the new EU Biodiversity Strategy for 2030 and an associated Action Plan, a comprehensive, ambitious, long-term plan for protecting nature and reversing the degradation of ecosystems. It is impossible to measure progress to the formulated targets without reliable and timely information on the status and trends of biodiversity across Europe. Within the European Union, indicators on status and trends of species and ecosystems are reported under the Birds Directive (BD), the Habitats Directive (HD), the Water Framework Directive (WFD) and the Marine Strategy Framework Directive (MSFD). Additional information is needed, however, to establish a more comprehensive assessment of the state of ecosystems and their trends, covering the whole territory of Europe and the whole range of natural and semi-natural landscapes.

The EUNIS Habitat Classification, developed by the European Topic Centre for Biodiversity (TEC/BD) for the European Environment Agency (EEA) at the end of the last century (Davies & Moss 1999; see Davies et al. 2004; Moss 2008), is covering both the marine and terrestrial realm. In recent years, this classification is being revised, aiming at establishing more hierarchical consistency, remove ambiguity and overlap in definitions of types, and extend the typology for the complete European continent and seas. A preliminary, 2014 revised classification has been used in the DG ENV project Red List of European Habitat (Janssen et al. 2016).

One of the main aims of the EEA Framework contract is to support EEA and other European institutes with data and tools for assessment of ecosystem status and trends, including their provided services and functions. Task 1 of the framework contract focusses on enhancing ecosystem maps, using vegetation plot data. It was decided to split up the workload according to the EUNIS habitat groups, with yearly so-called specific contracts.

Under specific contract 3417/B2018/EEA.57264 implementing the above Framework Contract, EEA received updated crosswalks with the 2016 EuroVegChecklist, formal query routines and indicator species lists for the revised EUNIS habitat groups of *forest, heathland, scrub and tundra and grassland*. Initial work on these habitat groups was undertaken under four separate contracts between 2013 and 2016. EEA also received updated crosswalks between the Red List habitats (finalised by the end of 2016) and the current EUNIS terrestrial habitat types of version 2012, Annex I habitats, and the revised EUNIS forests, heaths and grasslands.

Under specific contract 3417/B2019/EEA57.640, EEA received updated crosswalks with the 2016 EuroVegChecklist, formal query routines and indicator species lists for the revised habitat groups of *coastal habitats and mires*. EEA also received updated crosswalks between Red List habitats (finalised by the end of 2016) and the revised EUNIS coastal habitats and mires.

Under specific contract 3417/B2019/EEA57.806, EEA received updated crosswalks with the 2016 EuroVegChecklist, formal query routines and indicator species lists for the revised EUNIS habitat groups of *vegetated man-made habitats*. Where appropriate, EEA also received aligned crosswalks between Red List habitats and Annex I habitats that were delivered in 2018 with crosswalks between revised EUNIS habitats and Annex I habitats for forests/heaths/grasslands/mires/coastal/marine habitats. EEA also received qualifiers between the revised EUNIS marine habitats and Red List habitats. The revised marine habitats include saltmarshes.

This year's work provides the next steps to the ongoing EUNIS habitat revisions, dealing with Saltmarshes and Inland habitats with no or little soil and mostly with sparse vegetation. The Saltmarshes are from the marine habitats group, the Inland habitats with no or little soil and mostly with sparse vegetation are defined as "non-coastal habitats on substrates with no or little development of soil, mostly with less than 30% vegetation cover which are dry or only seasonally wet (with the water table at or above ground level for less than half of the year). Habitats which may have a high vegetation cover include crevices of rocks, screes or cliffs and habitats formed by carpets of moss". The habitats belonging to this group were revised in 2018 based on the European Red List of Habitats (published in 2016) and Eionet public consultation. The last EUNIS habitat groups (inland waters and habitat complexes) will be revised at a later stage.

1.2 Aim and objectives of the Specific Contract

The support to EUNIS Habitat Classification revision comprises two specific tasks (A and B), both divided into two subtasks. The work comprises an update of crosswalks of EUNIS with EuroVegChecklist 2016 (Task A1), a provision of formal query routines and indicator species lists (= characteristic species combinations) (Task A2), a provision of crosswalks between European Red List habitats and revised EUNIS habitats (Task B1), and aligning crosswalks between Red List habitats and Annex I habitats with crosswalks between revised EUNIS habitats and Annex I habitats (Task B2).

In line with the earlier projects mentioned above, the updated version of EuroVegChecklist as published in 2016 (Mucina et al. 2016) was used as a reference for updating the crosswalks between the considered EUNIS habitat types and EuroVegChecklist. The need for updating the crosswalks was also requested from the side of the EUNIS classification, as the final EUNIS review

is based on the public consultation and differ from the ones proposed from the European Vegetation Survey (EVS) projects (see Par. 2.1). The development of the crosswalks has been done in close communication with ETC/BD. This task is a prerequisite to the following subtask on the identification of indicator species and to the production of maps (the maps will be produced by ETC/BD).

To execute formal query routines and to define indicator species for the individual habitat types, small-scale plot data on plant species composition and cover are applied, in line with the phytosociological tradition, where such *in situ* data are used for 'bottom-up' fine-grained delimitation and characterisation of so-called plant associations (Braun-Blanquet 1928). This type of vegetation research in Europe has resulted in an enormous amount of phytosociological publications describing and classifying vegetation types from many countries in the EU and beyond, whereas estimates indicate that there are more than two millions of such vegetation plot data in Europe. Making use of the capacity of *in situ* vegetation recording is part of the on-going review of information relating to habitat types and ecosystems by the EEA, anticipating a revision of the existing scientific basis for the EUNIS Habitat Classification. A large proportion of these *in situ* plot data are stored in the European Vegetation Archive (EVA), which is continuously extended and updated (*http://euroveg.org/eva-database*; Chytrý et al. 2016).

2 Update of crosswalks of the revised EUNIS Habitat Classification of Saltmarshes and Inland habitats with no or little soil and mostly with sparse vegetation with EuroVegChecklist 2016

2.1 Background

The update of crosswalks of EUNIS with *EuroVegChecklist* 2016 will replace earlier crosswalks based on previous versions of both classification systems. The updated version is presented in Appendix C.

The changes in the EUNIS Habitat Classification over the years were for a long time relatively modest, but more substantial revisions took place as a result of the work carried out through a number of European Vegetation Survey projects for the EEA (Schaminée et al. 2012, 2013, 2014, 2016a, 2016b, 2018, 2019, 2020), the DG-ENV analysis of the European Red List of Habitats (Janssen et al. 2016), further meeting and consultation by the EEA and ETC-BD of the vegetation experts involved, and public consultation in the 39 Eionet partnership countries.

The overview of European syntaxa has undergone substantial expert revision after the publication of *The Diversity of European Vegetation* in 2002, which was a first attempt to achieve a respectable level of stability in the classification of European vegetation (Rodwell et al. 2002), based on a list of European vegetation classes by Mucina, published in 1997 in a bundle of case studies by the EVS (Mucina in Rodwell et al. 1997). This major enterprise, an initiative of the EVS, was carried out by a team under the leadership of Ladislav Mucina, resulting in a new overview, the so-called *EuroVegChecklist*, which was published in 2016. Compared to the 2002 overview, *EuroVegChecklist* is geographically more comprehensive, scientifically more robust, and better grounded within current phytosociological understanding and data.

2.2 EuroVegChecklist 2016

The published version of *EuroVegChecklist* provides floristic hierarchical classification systems of vascular plant, bryophyte, lichen, and algal communities. The vascular plant communities include 109 classes, 300 orders, and 1108 alliances. It offers "The first comprehensive and critical account of European syntaxa and synthesizes more than a hundred years of classification effort by European phytosociologists. It aims to document and stabilize the concepts and nomenclature of the syntaxa for practical use, such as calibration of the habitat classification used by the European Union, standardization of terminology for environmental assessment, management and conservation of natural areas, landscape planning and education. The presented classification systems provide a baseline for future development and revision of European syntaxonomy", as stated in the summary of the paper (Mucina et al. 2016).

The revised overview not only gives the lists of syntaxa, but it also briefly characterizes – in ecological and geographic terms – the accepted syntaxonomic concepts, links available synonyms to the accepted syntaxonomic concepts, and provides lists of diagnostic species for all classes.

The plant communities of the "conspectus of the high ranked syntaxa of the European vegetation dominated by vascular plants" are divided into three main groups (Zonal and intrazonal vegetation, Azonal vegetation and Anthropogenic vegetation), which are further ordered along the main geographic zones. The group of the Zonal and intrazonal vegetation, for instance, comprises seven subgroups of vegetation types for respectively the arctic zone, boreal zone, nemoral forest zone, steppe zone, continental desert zone, Mediterranean zone, and the Canary Islands, Madeira and Azores.

EuroVegChecklist is also published on the web (www.synbiosys.alterra.nl/evc), where the publication can be downloaded, and comments can be posted. Within the EVS, a committee has been established and procedures formulated and approved by the EVS Business Meeting in Bilbao on 14 September 2017, to guide and harmonize proposals for future changes to the European vegetation classification.

2.3 Some remarks on the revised EUNIS Habitat Classification for Saltmarshes and Inland habitats with no or little soil and mostly with sparse vegetation

During the Kick-off meeting of the project on 14-04-2020 (via skype), it was confirmed that the project would evaluate all level 3 habitat types from the Revised EUNIS level 1 Group U (Inland habitats with no or little soil and mostly with sparse vegetation) for cross-walking with EuroVegChecklist, except for habitat types U1 (Terrestrial underground caves, cave systems, passages and waterbodies), U3E (Limestone pavement), U3F (Weathered rock and outcrop habitats), U4 (Snow or ice-dominated habitats, and U53 (Glacial moraines with very sparse or no vegetation). U3E and U53 are geomorphologically defined habitat types and as such difficult or even impossible to relate to alliances of the EuroVegChecklist. U3F has been analysed in an earlier project as part of the Grassland group (R12 and R13), whereas U1 and U4 are without any vegetation.

We recommend deleting the EUNIS habitat type U3F (Weathered rock and outcrop habitats) from the revised EUNIS typology as it overlaps completely with EUNIS grassland habitat R12 (Cryptogam- and annual-dominated vegetation on siliceous rock outcrops).

It was decided that Mediterranean siliceous scree would be added as a new EUNIS habitat type (U24) and proposed to change the order and coding of Inland sparsely vegetation habitats because it is inconsistent between screes and cliffs. For screes, the sorting is first according to acidic versus basic bedrock and then by biogeography, whereas in cliffs it is vice versa.

As the flora of walls has clear similarities with the vegetation of rocks, stones and cliffs, they have been covered too by the Inland habitats with no or little soil and mostly with sparse vegetation of group U (see Schaminée et al. 2019, pg. 10).

The Saltmarshes include the EUNIS habitat types with the codes MA211 (Arctic), MA221, MA222, MA223, MA224, MA225 (Atlantic), MA251, MA252, MA253 (Mediterranean), MA232 (Baltic), and MA241 (Black Sea). It was noticed that in the supporting Excel-file (Marine habitats with vascular plants) some of the descriptions are inaccurate or even missing. Therefore, it was decided to clarify the discrepancies and to define new descriptions where needed within the context of the project (Appendix B).

For the Saltmarshes, the EUNIS habitat types are defined according to geographic regions: Arctic, Atlantic, Baltic, Mediterranean and the Black Sea. For defining the marine boundaries, the maps of Biographic Regions in Europe (EEA 2016, https://www.eea.europa.eu/data-and-maps/data/biogeographical-regions-europe-3), in combination with the Marine Assessment area and regional sea groupings of the European Red List of Habitats Gubbay et al. 2016) are used as a starting point (see Chapter 3.3; Dinerstein et al. 2017). Following the concept of Gubbay and co-workers, this would result in the following delimitations: For the arctic saltmarshes, the boundaries of the Arctic Biographical Region are extended by the White Sea area of the boreal Biogeographic Region. The Atlantic saltmarshes are limited to the remaining coasts of the European part of the Atlantic Ocean extending southwards up to the Straits of Gibraltar and including the Canary Islands and Madeira. The Mediterranean saltmarshes follow the boundaries of the Mediterranean Sea. The Black Sea saltmarshes, finally, include the Sea of Marmara and are extended with the Sea of Azov. Up to now, the saltmarshes of the Caspian Sea are not covered by the EUNIS classification and need further investigation. The chosen borders between the geographic regions are in line with the earlier work on Coastal habitats (group N; Schaminée et al. 2019). A classification based on these borders was also published in the EUNIS paper in Applied Vegetation Science (Chytrý et al. 2020).

For the analysis of the Saltmarshes, a European Coastline Map with a buffer of 5 kilometres was applied to filter the relevant relevés from the EVA database. This is also important for separating coastal saltmarshes from inland saltmarshes.

The SynBioSys Taxon Database (as being in use in EVA, Turboveg, and EEA and ETC-BD projects) is linked with the Euro+Med PlantBase to have one general taxonomy and (even more important) to make use of all the links that are already synonymized within the SynBioSys list (more than 25 national and regional standardised floras).

3 Formal query routines and characteristic species combinations for the revised EUNIS classification of Saltmarshes and Inland habitats with no or little soil and mostly with sparse vegetation

3.1 Background

In our previous work (Schaminée et al. 2012, 2013, 2014, 2016a, 2016b, 2018, 2019), we produced lists of characteristic species combinations (called 'indicator species' in the previous reports) for EUNIS habitat types of coastal habitats (habitat group N), wetlands (group Q), grasslands (group R), heathlands, scrub and tundra (group S), forests (group T) and man-made habitats (group V). For the identification of EUNIS habitats in the vegetation-plot databases, we created an electronic expert system EUNIS-ESy, based on the principles and methods developed by Bruelheide (1995, 1997, 2000), Kočí et al. (2003), Chytrý (2007; see also Chytrý & Tichý 2018), Landucci et al. (2015), Mucina et al. (2016) and Tichý et al. (2019), with further modifications. The previous work was also summarized in a reviewed scientific paper (Chytrý et al. 2020). Here we use the term 'characteristic species combination' instead of 'indicator species', because the latter term was criticised as inappropriate by reviewers of the paper Chytrý et al. (2020).

The expert system was developed as a software tool implemented in the Juice 7.1 software (Tichý 2002) and the Turboveg 3 software (Hennekens 2015). The software uses formal definitions of individual habitats, which are written as logical formulas in an editable expert system script stored as a TXT file (see Appendix D). Each plot from a vegetation database submitted to the software is checked to test whether it meets the conditions of some of the formal definitions of habitats included in this script. If it does, it is assigned to this habitat. For further details on the expert system and the way it operates, we refer to Chytrý et al. (2020).

Vegetation plots (phytosociological relevés) belonging to individual habitat types (henceforth 'habitats') were identified in the databases of the European Vegetation Archive (Chytrý et al. 2016) and some other databases obtained for this project (see Appendix F).

3.2 Data sources

The primary data source for producing lists of characteristic species combinations were European vegetation-plot records. Such plots typically contain a full list of vascular (and often also non-vascular) plant species, estimation of cover-abundance of each species, location and various additional information on vegetation structure and environmental features in the plot

(Dengler et al. 2011). These plots were compiled from the EVA database (Chytrý et al. 2016) and several other databases not included in EVA but provided for this analysis (see Appendix F). We used an export from the EVA database, version 19 May 2020, containing 1,261,373 vegetation plots.

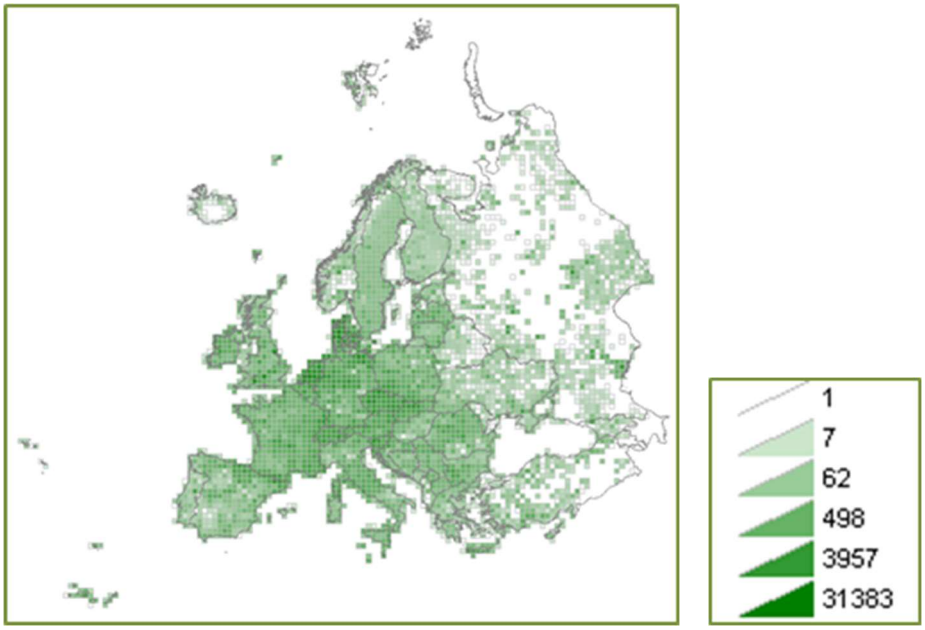

Figure 3.1. Density of georeferenced plots in EVA and other plots provided for this project in 50 x 50 km grid cells (accessed on 19 May 2020).

The taxon names in this dataset originated from several source databases managed in Turboveg 2 (Hennekens & Schaminée 2001), which use different taxon lists with partly inconsistent taxonomic concepts and nomenclature. Taxon names were unified using the Turboveg 3 program (Hennekens 2015), applying a two-step approach as described by Chytrý et al. (2020). The documentation of the first step is provided in the archive Nomenclature-translation-from-Turboveg-2-databases.zip published at *https://doi.org/10.5281/zenodo.3841729*. The documentation of the second step is provided in Section 1 of the updated EUNIS-ESy expert system in Appendix D.

3.3 Formal query routines

We developed the formal query routines using the same methodology as described in our previous work on other habitat types, in which formal definitions of habitat types are based on plant species composition, the dominance of specific plant species, and optionally also geographical criteria

(Chytrý et al. 2020). These query routines were added to the updated EUNIS-ESy expert system (Appendix D).

For vegetated marine habitats, we were able to define all habitat types of saltmarshes from MA211 to MA253. Based on the European phytosociological literature and our field experience, we defined species groups that are typical of drift lines and pioneer, low, middle and upper saltmarshes. The geographic position of the vegetation plots was also used in the definitions, because individual EUNIS habitat types are defined according to geographic regions: Arctic, Atlantic, Baltic, Mediterranean and the Black Sea. We did not consider the Caspian Sea, because up to now, the saltmarshes of the Caspian Sea are not covered by the EUNIS classification and need further investigation.

For Inland habitats with no or little soil and mostly with sparse vegetation (habitat group U), we used the total vegetation cover of 30 % as the upper threshold for the assignment of a vegetation-plot record to this group. We compiled lists of inland scree and cliff specialist plant species, which we further divided into those of siliceous high-mountain habitats, siliceous lowland to montane habitats, base-rich high-mountain habitats, base-rich lowland to montane habitats, ultramafic habitats and wet habitats. Further, we identified whether the plots occurred in the arctic + boreal zone, temperate zone or in the Mediterranean region using the Ecoregions defined by Dinerstein et al. (2017; see https://ecoregions 2017.appsp ot.com/). We combined these criteria to establish the query routines for individual habitat types.

Using this approach, we were able to define all the Level-3 habitats of screes (U2) and all the Level-3 habitats of cliffs (U3) except for U3E Limestone pavement and U3F Weathered rock and outcrop habitat, which are both defined by abiotic features while they can support a broad range of different vegetation types, including mosaics of different types. Further, we were able to define the habitats U52 Polar desert, U61 Subarctic volcanic field and U62 Mediterranean, Macaronesian and temperate volcanic field. In contrast, we were not able to define the habitat U51 Fjell field. This habitat is defined, to a large extent, by abiotic features (occurrence on exposed landforms), and its floristic composition overlaps with other habitats, in particular with S12 Moss and lichen tundra, and partly also with S11 Shrub tundra.

A total of 1,261,373 vegetation plots were used for the analysis (Figure 3.1). Excluded were plots that did not meet certain criteria, such as very small and very large plots and plots with a location uncertainty greater than 10 km. Of the resulting dataset set, 20,700 plots were classified as saltmarsh habitats. Further, 6,367 plots were classified as inland sparsely vegetated habitats. We found that no plots were assigned to the habitats U31 Boreal and arctic siliceous inland cliff and U39 Boreal ultramafic inland cliff, although they were both defined in the expert system. The reason is the general scarcity of vegetation-plot data from Scandinavian cliffs. Collection of field data is needed in the future. Also, only one plot was classified to the habitat U2A Crimean base-rich

scree, which is a locally restricted and not very well sampled habitat. An overview of the number of plots classified to individual habitats is shown in Table 4.1).

Table 4.1. Number of plots classified to to individual habitats of EUNIS groups MA and U.

MA211 Arctic coastal saltmarsh	345
MA221 Atlantic saltmarsh driftline	78
MA222 Atlantic upper saltmarsh	688
MA223 Atlantic upper-mid saltmarsh and saline and brackish reed, rush sedge bed	5685
MA224 Atlantic mid-low saltmarsh	7637
MA225 Atlantic pioneer saltmarsh	1259
MA232 Baltic coastal meadow	563
MA241 Black Sea littoral saltmarsh	1121
MA251 Mediterranean upper saltmarsh	266
MA252 Mediterranean upper-mid saltmarsh and saline and brackish reed, rush and sedge bed	998
MA253 Mediterranean mid-low saltmarsh	2060
U21 Boreal and Arctic siliceous scree and block field	28
U22 Temperate high-mountain siliceous scree	625
U23 Temperate, lowland to montane siliceous scree	121
U24 Mediterranean siliceous scree	146
U25 Boreal and Arctic base-rich scree and block field	34
U26 Temperate high-mountain base-rich scree and moraine	986
U27 Temperate, lowland to montane base-rich scree	1240
U28 Western Mediterranean base-rich scree	114
U29 Eastern Mediterranean base-rich scree	105
U2A Crimean base-rich scree	1
U31 Boreal and Arctic siliceous inland cliff	0
U32 Temperate high-mountain siliceous inland cliff	156
U33 Temperate, lowland to montane siliceous inland cliff	275
U34 Mediterranean siliceous inland cliff	139
U35 Boreal and Arctic base-rich inland cliff	12
U36 Temperate high-mountain base-rich inland cliff	451
U37 Temperate, lowland to montane base-rich inland cliff	1210
U38 Mediterranean base-rich inland cliff	461
U39 Boreal ultramafic inland cliff	0
U3A Temperate ultramafic inland cliff	45
U3B Mediterranean ultramafic inland cliff	9
U3C Macaronesian inland cliff	52
U3D Wet inland cliff	77
U52 Polar desert	5
U61 Subarctic volcanic field	20

4 Crosswalks between European Red List of habitats and revised EUNIS habitats and aligning crosswalks between Red List habitats and Annex I habitats with crosswalks between revised EUNIS habitats and Annex I habitats

4.1 European Red List of Habitats

The European Red List of Habitats project has been carried out during the period 2014-2016 on behalf of the European Commission DG Environment (Gubbay et al. 2016; Janssen et al. 2016).). The project aimed at providing a Red List assessment of all natural and semi-natural terrestrial, freshwater and marine habitats in the EU28 and beyond. For the Red List, the EUNIS typology was applied, with some adaptations. These adaptations followed the proposed new EUNIS which were published in the same period for forest, scrub and grassland habitats (Schaminée et al. 2014, 2016a), as well as proposals for other habitat groups. The latter formed the basis for the new EUNIS proposals in the following years.

For terrestrial habitats, the Red List of European Habitats was organised in seven expert groups according to EUNIS main types (coastal habitats, freshwater types, mires and bogs, grasslands, heathland and scrub, forests, and sparsely vegetated habitats). The Red List applied the criteria and categories according to the IUCN guidelines (with some slight adaptations) and was based on data sources and expert knowledge of about 300 experts from 33 countries. In total, a red list assessment was carried out for 235 terrestrial and freshwater habitats and 257 marine habitats. The information made public through factsheets contains much more information for these habitat types, including crosswalks to other classifications, lists of characteristic species, photos, distribution maps, pressures and threats, conservation measures, and data on occurrences in individual countries.

4.2 Crosswalks between European Red List of habitats and revised EUNIS habitats

The crosswalks have been established on Level 3 of EUNIS, which corresponds to the level of terrestrial Red List typology. The Red List typology was originally based on EUNIS level 3. Additionally, it has been indicated whether old EUNIS types relate to 'other' habitats which are not included within the Red List typology, for example, because they occur outside the geographical scope of the Red List project (which covers the former EU28 and Iceland, Norway, Switzerland and the Balkan countries). The crosswalks concern only the Inland habitats with no or little soil and mostly with sparse vegetation. Crosswalks between Saltmarshes and Red List habtiats were developed in a previous contract in 2019.

4.3 Aligning crosswalks between Red List habitats and Annex I habitats with crosswalks between revised EUNIS habitats and Annex I habitats

For Inland habitats with no or little soil and mostly with sparse vegetation, the crosswalks between both revised EUNIS and Red List habitats to Annex I have been checked and corrected where needed, in order to align both crosswalks to Annex I. The final output is a spreadsheet, with qualifiers, showing the crosswalks between Annex I and the inland sparsely vegetated Red List typology. In the report, the resulting spreadsheet is included in Appendix H (electronic files).

We found one crosslink that requires a correction in the earlier provided crosswalks for heathlands and scrub. Part of the Annex I type 8320 corresponds to EUNIS types S76 Canarian mountain hedgehog-heath and S74 Central Mediterranean mountain hedgehog-heath. Therefore, this Annex I type should be added to the crosswalks for these two heathland types and also to the crosswalks of the relevant Red List habitas.

5 References

Bruelheide, H. (1995). Die Grünlandgesellschaften des Harzes und ihre Standortsbedingungen. Mit einem Beitrag zum Gliederungsprinzip auf der Basis von statistisch ermittelten Artengruppen. *Dissertationes Botanicae* 244 1–338.

Bruelheide, H. (1997). Using formal logic to classify vegetation. *Folia Geobotanica et Phytotaxonomica* 32: 41–46.

Bruelheide, H. (2000). A new measure of fidelity and its application to defining species groups. *Journal of Vegetation Science* 11: 167-178.

Chytrý, M. (ed.; 2007). *Vegetace České republiky 1. Travinná a keříčková vegetace. Vegetation of the Czech Republic 1. Grassland and heathland vegetation*. Academia. Praha, Czech Republic.

Chytrý, M., Hennekens, S.M., Jiménez-Alfaro, B., Knollová, I., Dengler, J., Jansen, F., Landucci, F., Schaminée, J.H.J. et al. (2016). European Vegetation Archive (EVA): an integrated database of European vegetation plots. *Applied Vegetation Science* 19: 173–180.

Chytrý, M. & Tichý, L. (2018). National vegetation classification of the Czech Republic: a summary of the approach. *Phytocoenologia* 48 (2): 121-131.

Chytrý, M., Tichý, L., Hennekens, S.M., Knollová, I., Janssen, J.A.M., Rodwell, J.S., Peterka, T., Marcenò, C., Landucci, F., Danihelka, J., Hájek, M., Dengler, J., Novák, P., Zukal, D., Jiménez-Alfaro, B., Mucina, L., Abdulhak, S. [...] & Schaminée, J.H.J. (2020). EUNIS Habitat Classification: expert system, characteristic species combinations and distribution maps of European habitats. *Applied Vegetation Science* online, accepted 27 July 2020.

Costa, J.C., P. Arséno, T. Monteiro-Henriques, C. Neto, E. Pereira, T. Almeida & J. Izco (2009). Finding the Boundary between Eurosiberian and Mediterranean Salt Marshes. *Journal of Coastal Ecology* 56: 1340-1344.

Davies, C. & Moss, D. (1999). *EUNIS Habitats Classification*. Final report to the European Topic Centre on Nature Conservation, European Environment Agency. Institute of Terrestrial Ecology, Huntingdon, UK.

Davies, C.E., Moss, D. & Hill, M.O. (2004). *EUNIS Habitat Classification*. European Environment Agency, Copenhagen.

Dengler J., Jansen F., Glöckler F., Peet R.K., De Cáceres M., Chytrý M., ... & Spencer, N. (2011). The Global Index of Vegetation-Plot Databases (GIVD): a new resource for vegetation science. *Journal of Vegetation Science* 22: 582–597.

Dinerstein, E., Olson, D., Joshi, A., Vynne, C., Burgess, N.D., Wikramanayake, E. et al. (2017) An ecoregion-based approach to protecting half the terrestrial realm. *BioScience* 67: 534–545. https://doi.org/10.1093/biosci/bix014

Gubbay, S., Sanders, N., Haynes, T., Janssen, J.A.M., Rodwell, J.R., Nieto, A., García Criado, M., Beal, S., Borg, J., Kennedy, M., Micu, D., Otero, M., Saunders, G. & Calix, M. (2016). *European Red List of Habitats – Part 1. Marine habitats*. Luxembourg: Publications Office of the European Union.

Hennekens, S.M. (2015). Turboveg 3. A gateway to EVA and other databases. In: Chytrý, M., Zelený, D. & Hettenbergerová, E. (ed.), *Understanding broad-scale vegetation patterns.* Book of Abstracts, 58th Annual Symposium of the International Association for Vegetation Science. Masaryk University, Brno, p. 152.

Janssen, J.A.M., Rodwell, J.S., García Criado, M., Gubbay, S., Haynes, T., Nieto, A., ... Valachovič, M. (2016). European Red List of Habitats – Part 2. Terrestrial and freshwater habitats. Luxembourg: Publications Office of the European Union.

Kočí, M., Chytrý, M. & Tichý, L. (2003). Formalized reproduction of an expert-based phytosociological classification: A case study of subalpine tall-forb vegetation. *Journal of Vegetation Science* 14: 601–610.

Landucci, F., Tichý, L., Šumberová, K. & Chytrý, M. (2015). Formalized classification of species-poor vegetation: a proposal of a consistent protocol for aquatic vegetation. *Journal of Vegetation Science* 26: 791–803.

Moss, D. (2008). *EUNIS Habitat Classification – a guide for users*. European Topic Centre on Biological Diversity, Paris, and European Environment Agency, Copenhagen.

Mucina, L., Bültmann, H., Dierßen, K., Theurillat, J.-P., Raus, T., Čarni, A., ... & Tichý, L. (2016). Vegetation of Europe. Hierarchical floristic classification system of vascular plant, bryophyte, lichen, and algal communities. *Applied Vegetation Science* 19, Suppl. 1: 3–264.

Rodwell, J.S., Mucina, L., Pignatti, S., Schaminée, J.H.J. & Chytrý, M. (1997, red.). *European Vegetation Survey: Case Studies*. Special features in vegetation science 14. Opulus Press, Uppsala, 238 pp.

Rodwell, J.S., Schaminée, J.H.J., Mucina, L., Pignatti, S., Dring, J. & Moss, D. (2002). *The Diversity of European Vegetation. An overview of phytosociological alliances and their relationships to EUNIS habitats*. Rapport EC-LNV 2000/054, Wageningen, 168 pp.

Schaminée, J.H.J., Hennekens, S.M., Chytrý, M. & Rodwell, J.S. (2009). Vegetation-plot data and databases in Europe: an overview. *Preslia* 81: 173–185.

Schaminée, J.H.J., Chytrý, M., Hennekens, S.M., Mucina, L., Rodwell, J.S. & Tichý, L. (2012). D*evelopment of vegetation syntaxa crosswalks to EUNIS Habitat Classification and related data sets*. Report to the European Environmental Agency. Alterra WUR, Wageningen, the Netherlands.

Schaminée, J.H.J., Chytrý, M., Hennekens, S.M., Jiménez-Alfaro, B., Mucina, L., Rodwell, J.S. & Tichý, L. (2013). *Review of EUNIS forest Habitat Classification*. Report to the European Environmental Agency. Alterra WUR, Wageningen, the Netherlands.

Schaminée, J.H.J., Chytrý, M., Hennekens, S.M., Janssen, J.A.M., Jiménez-Alfaro, B., Knollová, I., Mucina, L., Rodwell, J.S. & Tichý, L. (2014). *Vegetation analysis and distribution maps for EUNIS habitats*. Report to the European Environmental Agency (EEA/NSV/14/006). Alterra WUR, Wageningen, the Netherlands.

Schaminée, J.H.J., Chytrý, M., Hennekens, S.M., Janssen, J.A.M., Jiménez-Alfaro, B., Knollová, I., Marcenò, C., Mucina, L., Rodwell, J.S., Tichý, L. &

data providers (2016a). *Review of grassland habitats and development of distribution maps of heathland, scrub and tundra habitats of EUNIS habitats classification*. Report to the European Environmental Agency. Alterra WUR, Wageningen, the Netherlands.

Schaminée, J.H.J., Chytrý, M., Dengler, J., Hennekens, S.M., Janssen, J.A.M., Jiménez-Alfaro, B., Knollová, I., Landucci, F., Marcenò, C., Rodwell, J.S., Tichý, L. & data-providers (2016b). *Development of distribution maps of grassland habitats of EUNIS Habitat Classification*. Report to the European Environmental Agency (EEA/NSV/16/005). Alterra WUR, Wageningen, the Netherlands.

Schaminée, J.H.J., Chytrý, M., Hennekens, S.M., Janssen, J.A.M., Knollová, I., Rodwell, J.S., Tichý, L. & data-providers (2018). *Updated crosswalk of the revised EUNIS Habitat Classification with the European vegetation classification and indicator species for the EUNIS grassland, shrubland and forest types*. Report to the European Environmental Agency (EEA/NSS/17/002/Lot 1). Alterra WUR, Wageningen, the Netherlands.

Schaminée, J.H.J., Chytrý, M., Hájek, M., Hennekens, S.M., Janssen, J.A.M., Jiroušek, M., Knollová, I., Marcenò, C., Peterka, T., Rodwell, J.S., Tichý, L. & data-providers (2019). *Updated crosswalks of the revised EUNIS Habitat Classification with the European Vegetation Classification and the European Red List Habitats for EUNIS coastal habitats and wetlands - Formal query routines and indicator species*. Report to the European Environmental Agency (EEA/NSS/17/002/Lot 1). Wageningen Environmental Research, the Netherlands.

Schaminée J.H.J., Chytrý M., Hennekens S.M., Janssen J.A.M., Knollová I., Lososová Z., Marcenò C., Tichý L. & data providers (2020). Updated crosswalks, formal query routines and indicator species of the revised EUNIS Habitat Classification with the European Vegetation Classification for vegetated man-made habitats and aligning of crosswalks between European Red List habitats and Annex I habitats with crosswalks between EUNIS habitats and Annex I habitats. Report to the European Environment Agency (EEA/NSS/17/002/Lot 1). Wageningen Environmental Research, the Netherlands.

Storkey, J., Meyer, S., Still, K. S., & Leuschner, C. (2012). The impact of agricultural intensification and land-use change on the European arable flora. *Proceedings of the Royal Society B: Biological Sciences 279 (1732)*: 1421–1429.

Tichý, L. (2002). JUICE, software for vegetation classification. *Journal of Vegetation Science* 13: 451–453.

Tichý, L., Chytrý, M., & Landucci, F. (2019). GRIMP: A machine-learning method for improving groups of discriminating species in expert systems for vegetation classification. *Journal of Vegetation Science* 30: 5–17.

Appendix A: List of the revised EUNIS Habitat Classification for Saltmarshes and Inland habitats with no or little soil and mostly with sparse vegetation, including an indication of the availability of a distribution map and a EUNIS-syntaxon crosswalk

New code	EUNIS 2012 code	Habitat name	Distribution map & Indicators species	EUNIS-Syntaxon crosswalk
MA2	A2.5	Littoral biogenic habitat		
MA21	A2.5	Arctic Littoral biogenic habitat		
MA211	A2.5	Arctic coastal saltmarshes	x	x
MA22	A2.5	Atlantic littoral biogenic habitat		
MA221	A2.5	Atlantic saltmarsh driftline	x	x
MA222	A2.5	Atlantic upper saltmarshes	x	x
MA223	A2.5	Atlantic upper-mid saltmarshes and saline and brackish reed, rush and sedge beds	x	x
MA224	A2.5	Atlantic mid-low saltmarshes	x	x
MA225	A2.5	Atlantic pioneer saltmarshes	x	x
MA23	A2.5	Baltic hydrolittoral biogenic habitat		
MA232	A2.5	Baltic coastal meadow	x	x
MA24	A2.5	lack sea littoral biogenic habitats		

MA241	A2.5	Black Sea littoral saltmarshes	x	x
MA25	A2.5	Mediterranean littoral biogenic habitat		
MA251	A2.5	Mediterranean upper saltmarshes	x	x
MA252	A2.5	Mediterranean upper-mid saltmarshes and saline and brackish reed, rush and sedge beds	x	x
MA253	A2.5	Mediterranean mid-low saltmarshes	x	x
U	H	Inland habitats with no or little soil and mostly with sparse vegetation		
U1	H1	Terrestrial underground caves, cave systems, passages and waterbodies		
U11	H1.1; H1.2; H1.3; H1.4	Cave	-	-
U12	H1.7	Disused underground mines and tunnels	-	-
U2	H2	Screes		
U21	H2.1	Boreal and arctic siliceous scree and block field	x	x
U22	H2.3	Temperate high-mountain siliceous scree	x	x

U23	H2.5	Temperate, lowland to montane siliceous scree	x	x
U24	H2.5	Mediterranean siliceous scree	x	x
U25	H2.2	Boreal and arctic base-rich scree and block field	x	x
U26	H2.4	Temperate high-mountain base-rich scree and moraine	x	x
U27	H2.6	Temperate, lowland to montane base-rich scree	x	x
U28	H2.6	Western Mediterranean base-rich scree	x	x
U29	H2.6	Eastern Mediterranean base-rich scree	x	x
U2A	H2.6	Crimean base-rich screes	x	x
U3	H3	Inland cliffs, rock pavements and outcrops		
U31	H3.1	Boreal and arctic siliceous inland cliff	-	x
U32	H3.1	Temperate high-mountain siliceous inland cliff	x	x
U33	H3.1	Temperate, lowland to montane siliceous inland cliff	x	x
U34	H3.1	Mediterranean siliceous inland cliff	x	x
U35	H3.2	Boreal and arctic base-rich inland cliff	x	x

U36	H3.2	Temperate high-mountain base-rich inland cliff	x	x
U37	H3.2	Temperate, lowland to montane base-rich inland cliff	x	x
U38	H3.2	Mediterranean base-rich inland cliff	x	x
U39	H3.2	Boreal ultramafic inland cliff	-	x
U3A	H3.2	Temperate ultramafic inland cliff	x	x
U3B	H3.2	Mediterranean ultramafic inland cliff	x	x
U3C	H3.3	Macaronesian inland cliff	x	x
U3D	H3.4	Wet inland cliff	x	x
U3E	H3.5	Limestone pavement	-	-
U4	H4	Snow or ice-dominated habitats		
U41	H4.1	Snow pack	-	-
U42	H4.2	Ice cap and glacier	-	-
U43	H4.3	Rock glacier and unvegetated ice-dominated moraine	-	-
U5	H5	Miscellaneous inland habitats usually with very sparse or no vegetation		
U51	H5-1; H5.11	Fjell field	-	-
U52	H5.1	Polar desert	x	x
U53	H5.2	Glacial moraines with very sparse or no vegetation	-	-

U6	H6	Recent volcanic features		
U61	H6.1 H6.2	Subarctic volcanic field	x	-
U62	H6.1; H6.2	Mediterranean, Macaronesian and temperate volcanic field	x	x

Appendix B: Descriptions of the revised EUNIS Habitat Classification for Saltmarshes

New code	Habitat name	Description
MA211	Arctic coastal saltmarshes	Salt marshes along muddy and sandy intertidal shores in Arctic Europe dominated by halophytic plants with a circumpolar distribution. Stands are usually small and often occurring in a mosaic with bare sediment, as they are subject to erosion by waves and ice. Although the tidal differences are relatively low, the species composition varies according to the frequency and duration of flooding.
MA221	Atlantic saltmarsh driftline	Driftline communities with annual nitrophilous plant species along and inside Atlantic salt marshes, often with a linear structure in the upper zone incidentally or regularly flooded by high tides. Species composition indicates both high nutrient content and saline conditions.
MA222	Atlantic upper saltmarshes	Upper zone of Atlantic salt marshes, with fluctuating salinity and often influenced by freshwater seepage from surrounding dunes. This specific setting is reflected by species ranging from obligate halophytes to brackish and freshwater and dry dune indicators. Stands are often small and ephemeral, often embedded in wet grassland or dry dune habitat. They may be relatively species-rich, with many annuals.
MA223	Atlantic upper-mid saltmarshes and saline and brackish reed, rush and sedge beds	Middle zone of Atlantic salt marshes with closed swards of graminoids, herbs and low shrubs on sandy or clayey flats. The communities are regularly but not daily flooded by seawater. Helophytes may dominate in areas with freshwater influence. The communities are grazed or occur in unmanaged situations.

MA224	Atlantic mid-low saltmarshes	Low zone of Atlantic salt marshes with open to closed swards of halophytic graminoids, herbs and low shrubs on sandy or clayey flats. The communities are regularly flooded (100-200 days/year) by seawater. In the southern part of the distribution range, perennial glassworts may dominate, indicating transitions toward Mediterranean salt marshes.
MA225	Atlantic pioneer saltmarshes	Pioneer zone of Atlantic salt marshes with open vegetation dominated by annual chenopodioids and grasses (*Spartina*). Stands are daily (twice) flooded by seawater and relatively species-poor. Dominating species are obligate halophytes and may occupy both sandy and clayey sites.
MA232	Baltic coastal meadow	Baltic coastal meadows, mostly with short vegetation in the geolittoral zone (above the mean high tide). Salinity is low (brackish water), and tidal ranges are small. Most of the areas were traditionally used for mowing or grazing. Abandonment of traditional management leads to the dominance of reed beds. Although the tidal range is small, the vegetation occurs in distinct zones, with saline vegetation closest to the sea.
MA241	Black Sea littoral saltmarshes	Black Sea salt marshes on sandy and muddy substrates along sheltered shores, characterized by small tidal ranges and relatively low salinity. Tall rushes dominate at most sites, but locally shrub and herb communities may occur that are typical of inland continental salt pans. Due to desiccation, the substrate of such communities in the upper zone can be hypersaline.
MA251	Mediterranean upper saltmarshes	Open communities of the upper fringe of Mediterranean salt marshes, dominated by annual species, often under the influence of salt spray. The vegetation often occupies small but relatively species-rich patches. Many species are vernal, ending their life cycle before summer, and many are also found outside the coastal region.

MA252	Mediterranean upper-mid saltmarshes and saline and brackish reed, rush and sedge beds	Open to closed rush communities on the high zone of Mediterranean salt marshes, where flooding frequency (by seawater) is low. The vegetation generally occupies small belts and patches, in line with the limited tidal range of the Mediterranean Sea. Inbetween the rushes, a range of halophytic grasses, herbs and low shrubs may be found.
MA253	Mediterranean mid-low saltmarshes	Open to closed halophytic communities of the lower tidal zone of Mediterranean salt marshes. Perennial chenopodioids dominate the species-poor vegetation. Different species of sea lavender form a characteristic element, some of which have a small distribution range. In the lowest parts, annual glassworts (*Salicornia*) and grasses (*Spartina*) are frequent.
U	Inland habitats with no or little soil and mostly with sparse vegetation	Non-coastal habitats on substrates with no or little development of soil, mostly with less than 30% vegetation cover, which are dry or only seasonally wet (with the water table at or above ground level for less than half of the year). Habitats which may have a high vegetation cover include crevices of rocks, screes or cliffs and habitats formed by moss carpets. Subterranean non-marine caves and passages including underground waters, disused underground mines and areas with permanent snow or surface ice other than marine ice bodies are also include in this habitat group.

U1	Terrestrial underground caves, cave systems, passages and waterbodies	Natural caves, cave systems, underground waters and subterranean interstitial spaces. Caves and their associated waters harbour varied but species-poor communities of animals, fungi and algae that are restricted to them (troglobiont organisms), or are physiologically and ecologically capable of conducting their entire life cycle within them (troglophile organisms), or are dependent on them for part of the life cycle (subtroglophile organisms). Underground waters not associated with caves (stygon) and interstitial spaces harbour distinctive faunas.
U11	Cave	Caves originate over very long time periods and are very diverse in extent, configuration and character, some dry, others permanently or seasonally wet, others warm, deoxygenated and variously lit at cave entrances. They occur throughout Europe but are most extensive in karstic areas. Flora and fauna are specialized, adapted to often extreme environmental conditions and include some remarkable troglophiles or distinctive roosting or seasonally dormant creatures.
U12	Disused underground mines and tunnels	Artificial underground spaces. They may constitute important substitution habitats for cave-dwelling bats and significant subterranean invertebrates such as crustaceans or planarians.

U2	Screes	Accumulations of boulders, stones, rock fragments, pebbles, gravels or finer material of non-aeolian and non-fluvial depositional origin, unvegetated, occupied by bryophytes or lichens, or colonized by sparse herbs or shrubs. Included are screes and scree slopes produced by slope processes, moraines and drumlins originating from glacial deposition, sandar, eskers and kames resulting from fluvio-glacial deposition, block slopes, block streams and block fields constructed by periglacial depositional processes of downslope mass movement, and ancient beach deposits constituted by former coastal constructional processes. Deposits originating from aeolian depositional processes (dunes) or eruptive volcanic activity are excluded (they are included in U5 and U6, respectively). High mountain, boreal and Mediterranean unstable screes are colonized by highly specialized plant communities. They or their constituting species may also inhabit moraines and other depositional debris accumulations in the same areas. A very few communities form in lowland areas elsewhere.
U21	Boreal and arctic siliceous scree and block field	Boreal and Arctic sparsely vegetated siliceous boulders, stones or gravel screes occurring over base-poor substrates that harbour acidophilous plant communities. They are of diverse origin, uneven distribution through the region and often subject to continuing natural disturbance through rock falls, freeze-thaw or coastal erosion and deposition. The vegetation typically consists of bryophytes and lichens with different growth forms dominating different microhabitats, e.g. small cushion-forming bryophytes and crustose and foliose lichens on the sides of boulders, and mat-forming bryophytes and fruticose lichens in the hollows between blocks. Where vascular plants find enough soil between blocks, they contribute a sparse cover.

U22	Temperate high-mountain siliceous scree	Siliceous, mostly acidic screes, moraines or stone rivers found at high altitudes and cool sites in mountain ranges through the nemoral zone of Europe. The screes are colonized by a range of mostly perennial, mostly acidophilous plants. Their composition is strongly influenced by altitude and regional climate. There are many relict and local endemic species, though less than on calcareous screes. Often the vegetation cover is sparse, but these screes can be more humid because of the impervious and water-retentive character of the substrates and long snow-lie encourage luxuriant growth and accumulation of humus.
U23	Temperate, lowland to montane siliceous scree	Siliceous screes and moraines of warm exposures, derived from a diversity of sedimentary, igneous and metamorphic rocks on the lower slopes of mountain ranges in the nemoral zone. Often the screes are mixed with fine soil. Vegetation can be completely lacking, but bryophyte or lichen-dominated, species-poor communities can occur on rock surfaces. The fine soil accumulated in crevices can support a variety of forb or fern-dominated vegetation. Siliceous screes, in general, have a lower species richness than calcareous screes but ferns can be diverse and luxuriant. Natural succession on more stable screes results in the development of scrub and woodland, not included here.

U24	Mediterranean siliceous scree	Siliceous screes derived from various sedimentary, igneous and metamorphic rocks occurring on lower slopes in the Mediterranean. Rock debris is often mixed with fine soil. Vegetation cover can be completely lacking or consisting only of bryophyte and lichen communities. In most cases, however, these screes support open vegetation of vascular plants, which tends to be poorer in species than Mediterranean calcareous screes. Natural succession is slower than in temperate screes. Screes overgrown with shrublands or forest do not belong to this habitat.
U25	Boreal and arctic base-rich scree and block field	Boreal and arctic base-rich screes and block fields comprise talus or freeze-thaw block fields of calcareous rocks in the southern boreal to arctic regions, mainly in the Scandinavian Mountains, Iceland and Svalbard. Because of the considerable variation in climate, the habitat harbours a large diversity of species and plant communities, but it includes only sparse assemblages of vascular plants growing in sparse patches. These are dependent on the natural or semi-natural disturbance regime, periodic rockfall and continuing instability of the substrate in the case of screes, and in some regions also a long tradition of grazing.
U26	Temperate high-mountain base-rich scree and moraine	Calcareous and calcschist screes occurring at high altitudes and cool sites in high mountain ranges through the nemoral zone of Europe. The screes are colonized by mostly perennial basiphilous species, comprising often rich assemblages with many endemic species.

U27	Temperate, lowland to montane base-rich scree	Screes of mostly coarse, unstabilized material derived from calcareous and dolomitic bedrocks in the lowlands, foothills and sub-montane zone of temperate Europe. Vegetation can be completely lacking, but rock surfaces can have bryophyte and lichen communities and, where crevices accumulate soil, the vascular plant component can be diverse and lush. Natural succession following stabilization of screes allows encroachment of shrubs and trees, vegetation not included in this habitat.
U28	Western Mediterranean base-rich scree	Calcareous and ultrabasic scree, with boulders, rock debris and riverine gravel derived from sedimentary and metamorphic rocks, ultramafics and basic volcanics occurring through the western Mediterranean, from lowlands to the high mountains. Epilithic bryophytes and lichens may be very diverse, particularly in the mountains, where they are mostly found in crevices and other shady and humid microsites of immobile boulders. The vascular plant vegetation comprises hemicryptophytes and chamaephytes adapted to the mechanical disturbance caused by scree movements, shortages in water supply and lack of fine-grained soil. The habitat becomes scarcer and more scattered in the foothills and lowlands and more prone to be affected by human disturbances, such as quarrying and infrastructure development. Nevertheless, high mountain screes are usually well preserved in a very natural state.

U29	Eastern Mediterranean base-rich scree	Calcareous and ultrabasic screes, with talus, boulder fields, glacier forefields, rock debris and riverine gravel banks, from the lowlands upwards to subnival levels in the eastern Mediterranean. Apart from epilithic bryophytes and lichens on rock outcrops and stable boulders, the vegetation consists mainly of specialist vascular plants adapted to the mobility of scree materials, the scarcity of fine-grained soil, mechanical disturbance, shortage of water and other physiological stresses. Towards the foothills and lowlands, the habitat becomes rarer and more scattered but more prone to be affected by human disturbances, especially in terms of species composition. However, high mountain screes are usually well preserved, most within protected areas, and therefore in a very natural state.
U2A	Crimean base-rich screes	Base rich screes formed from a variety of rock types including limestone, flysch and schists of the Crimean Peninsula.
U3	Inland cliffs, rock pavements and outcrops	Unvegetated, sparsely vegetated, and bryophyte or lichen vegetated cliffs, rock faces and rock pavements, not presently adjacent to the sea, and not resulting from recent volcanic activity. Parts of seacliffs free from the influence marine salt transported by waves or wind are included. Rock accumulations resulting from depositional processes are excluded and listed under U2 or U5.

U31	Boreal and arctic siliceous inland cliff	Siliceous rock faces and cliffs, mostly of hard crystalline rocks, soft mica schist and some volcanics, in the boreal and arctic biogeographical regions, though not including sea cliffs with salt spray influence or very wet, dripping vertical rock faces. The vegetation consists of a limited vascular flora growing in crevices and on ledges, with epilithic bryophytes, lichens as well as micro-algae on rock faces, overhangs and in all kinds of sheltered microsites. Although the rock types are all base-poor, they show marked variation in their chemical composition and stratigraphy and can harbour a great diversity of vascular plants and cryptogams in many different assemblages, differentiated into many microhabitats.
U32	Temperate high-mountain siliceous inland cliff	Siliceous cliffs and rock faces of acidic, mostly Palaeozoic, rocks in the high mountains of the nemoral zone. Slow weathering of these resistant rocks creates few niches for colonisation, and the vascular flora of the crevices and on ledges is rather species-poor but rich in epilithic lichens.
U33	Temperate, lowland to montane siliceous inland cliff	Siliceous rock walls and cliffs in the nemoral region except those in the high mountains and coastal cliffs subject to sea spray. They comprise diverse metamorphic, sedimentary and igneous rocks but also some non-calcareous but more or less base-rich igneous volcanics. The vegetation in the rock fissures and crevices consists of vascular plants such as small ferns, succulents and rosulate herbs, on the rock surface also mosses and hepatics, crustose and foliose lichens, micro-algae and other micro-organisms. Natural succession can lead to scrub and woodland development.

U34	Mediterranean siliceous inland cliff	Siliceous rock walls and cliffs from the lowlands to high mountains in the Mediterranean, formed chiefly of igneous or metamorphic rocks which offer a diversity of niches for colonisation depending on the rock texture, schistosity, moisture content and chemistry. Typically they have cushion or rosulate vascular plants, some of them succulent, ferns and dwarf shrubs, with bryophytes, lichens, epilithic and endolithic micro-organisms.
U35	Boreal and arctic base-rich inland cliff	Vegetated cliffs on base-rich (not ultramafic or salt-sprayed) bedrocks across the boreal region, including Scotland, and maybe Iceland. They are often rich in ferns, crustose lichens and, in sunless, damp situations, particularly in more oceanic areas, bryophytes.
U36	Temperate high-mountain base-rich inland cliff	Calcareous or base-rich rock faces and crevices at high altitudes of European mountain ranges in the temperate region. The chasmophytes, dwarf and cushion-like chamaephytes and hemicryptophytes, and numerous fern species and bryophytes, are very well adapted to the extreme habitat conditions, like strong solar radiation, a low water content, high day/night and seasonal temperature fluctuations, strong winds, and the absence of snow cover protection. The soil is in general very poorly developed but can accumulate in crevices. Variation in the vascular flora is high across the continent, and due to geographical isolation and variety in site conditions, numerous relict, endemic, rare and protected species can be found on these cliffs.

U37	Temperate, lowland to montane base-rich inland cliff	Calcareous or base-rich rock faces and crevices of the lowland to montane belts of European mountains in the temperate region. Though conditions are not so severe as at higher altitudes, plant species growing on these rocks are adapted to extreme habitat conditions, such as strong solar radiation, a low water content, strong fluctuations in day/night and seasonal temperature, strong winds, absence of snow cover, and poorly developed soil. Many endemic and rare species occur here.
U38	Mediterranean base-rich inland cliff	Cliffs of limestone, calcareous conglomerates and other base-rich rocks in the lowlands to high mountains throughout the Mediterranean basin (excluding salt-sprayed coastal situations). They are characterized by a diverse flora of calcicole perennial vascular plants, often of rosulate, prostrate, succulent and cushion form, tussock grasses, small ferns, dwarf shrubs, shrubs and sometimes woody climbers and small trees, rooted in fissures and crevices. There are also bryophytes, lichens and epi- and endolithic micro-organisms. Towards the foothills and lowlands, the habitat is more prone to be affected by human disturbances, especially its species composition. High-mountain cliffs are usually well preserved, with a high degree of naturalness.
U39	Boreal ultramafic inland cliff	Ultramafic inland cliffs of the boreal zone. They are characterized by a boreal flora of seed plants and ferns adapted to the serpentine substrate with its distinctive mineral content and by bryophyte and lichen assemblages that are partly typical of calcareous habitats, though not forming any luxuriant cover here.

U3A	Temperate ultramafic inland cliff	Warmer south-facing cliffs of ultramafic rocks from the lowlands to the alpine belt of the temperate zone. They have an open cover of a distinctive crevice-rooting flora, mostly annuals, grasses and certain ferns, specialized for the mineral content of the shallow soils. The habitat supports some endemic plants.
U3B	Mediterranean ultramafic inland cliff	Ultramafic rocks and cliffs away from the coast in the Mediterranean have a very scattered distribution and sustain a sparse but highly distinctive flora of a few ferns, seed plants and cryptogams especially adapted for growing in the fissures and crevices of this specific substrate.
U3C	Macaronesian inland cliff	Cliffs in Macaronesia away from coastal salt-spray with perennial vegetation of crevices and ledges. In some places, they are dominated by succulents, in others rich in ferns and bryophytes characteristic of shaded situations. They host several hundreds of taxa endemic to the Macaronesian archipelagoes.
U3D	Wet inland cliff	Permanently wet cliffs in temperate and Mediterranean regions, in often highly localized situations, where rock and earth surfaces are kept wet by water trickles, spray splashing and a sunless orientation. The characteristic flora is dominated by shade and moisture-tolerant vascular plants, luxuriant ferns and bryophytes, and green and blue-green algae.

U3E	Limestone pavement	Limestone pavements are landforms resulting from dissolution processes exerted on hard limestone tables probably formed by ancient glacial erosion and subsequent weathering. They occur in or around the Alps and the Apennines and in northern Atlantic and Baltic regions and comprise flat or sloping surfaces of limestone separated by a network of vertical fissures. The size, shape and regularity of the blocks vary according to the local character of the bedrock and the climate, and much of the surface is bare but slowly accumulating soil. The shelter of crevices provides a variety of situations for colonisation. Drought-resistant communities of cushions of bryophytes and lichens and fragments of dry tufted grasslands can occur in exposed situations, whereas there is a more luxuriant vegetation of ferns, herbs, shrubs and trees at sheltered sites. Wind and herbivores often curtail any surface spread. The composition of the flora contrasts markedly between the major areas of occurrence.
U4	Snow or ice-dominated habitats	High mountain zones and high-latitude landmasses occupied by glaciers or perennial snow. They may be inhabited by algae and invertebrates.
U41	Snow pack	Accumulations of snow that do not flow, found mainly at high latitudes or altitudes, often in sunless situations like shady gorges or avalanche corridors, persistent within the limits of permanent snow but elsewhere susceptible to melting in hot summers, especially if the preceding snowfalls have been light. Some bryophytes can survive in such a habitat, an abundance of unicellular algae can colour the snow, and certain insects feed on material released by melting.

U42	Ice cap and glacier	Glaciers are permanent or near-permanent ice masses created by the compaction of the snow accumulated in cold climates. These deposits, when they are under pressure, behave like a viscous liquid. So, a glacier is a mobile element, because of its ability to slowly flow along a slope under the effect of gravity. Different types of glacier exist. Characteristic for the arctic regions, ice sheets and ice caps are dome-like ice masses unconstrained by topography. In the large mountain ranges, but also in the arctic regions, most glaciers are constrained by topography including cirque glaciers, valley glaciers, mountain glaciers and piedmont glaciers. The smallest form of glaciers is derived from snow-drifting, avalanches, or ice deposition in cold-bottom karst dolines, called glacierets. These small ice masses may have an existence limited to a few years.
U43	Rock glacier and unvegetated ice-dominated moraine	Rock glaciers are a mixture of frozen rock detritus and ice of glacial or periglacial origin, forming a tongue-like mass which can flow very slowly under gravity found in extremely cold areas at high latitudes and altitudes in Europe. Ice-dominated moraines are masses of unconsolidated mineral debris found in the vicinity of retreating glaciers. Few organisms have the ability to colonize these particular habitats, because of the low temperatures and the mobility of the substrate, so the flora is limited to pioneer plants and lichens, occurring principally on the lateral and terminal borders of the detritus. Invertebrates increase with the developing vegetation cover.
U5	Miscellaneous inland habitats usually with very sparse or no vegetation	Miscellaneous bare habitats, including glacial moraines, freeze-thaw features, inland sand dunes, burnt ground and trampled areas. Vegetation, if present, is dominated by algae, lichens or bryophytes, with vascular plants absent or very sparse.

U51	Fjell field	Fjell field occurs on very exposed summits, ridges and slopes of mountains in the boreal and arctic zones. They are blown clear of snow in winter and have shallow stony soils, nutrient-poor and usually acidic, susceptible to freeze-thaw and sorting. The vegetation is determined by the strong winds and cold and dominated by bryophytes and fruticose lichens. The habitat is generally beyond the limit of pastoral farming but can be grazed by wild herbivores.
U52	Polar desert	Polar desert is characterized by extreme low summer temperatures, low precipitation and shallow, usually base-rich soils over permafrost and flat or low undulating relief. The habitat is often totally bare or has at most a very sparse low cover of rosette plants growing among bryophytes and lichens. A light snow cover can encourage somewhat more extensive growth and areas with higher precipitation where reindeer graze and defaecate benefit from more moisture and nutrients.
U53	Glacial moraines with very sparse or no vegetation	Glacial moraines that have lost their ice and which have not yet revegetated. Excludes moraines where ice is still dominant (U43).
U6	Recent volcanic features	Hard rock surfaces, rock jumbles, loose material deposits, soils, water bodies resulting from recent or present volcanic activity. They are unvegetated, occupied by bryophytes or lichens, or colonized by specialized, relatively sparse herb or shrub-dominated communities.

U61	Subarctic volcanic field	This habitat comprises sparsely vegetated volcanic features such as active volcanos, recently formed lava streams, and older lava fields and rocks, as well as volcanic slopes and plains in the subarctic and arctic regions of Europe, mostly on Iceland and parts of Jan Mayen. The rock surfaces and volcanic soils are only slowly colonized, nutrient-poor and subject to continuing effects of wind erosion and desiccation. Vascular plants and cryptogams are generally sparse, but accumulating soil and depressions with longer snow-lie may sustain more extensive vegetation.
U62	Mediterranean, Macaronesian and temperate volcanic field	Sparsely vegetated volcanic areas of Mediterranean and Macaronesian regions, comprising mostly recently deposited volcanic scoriae (tephra), lava flows or orifices in volcanic areas emitting hot gases and vapours in Italy and the Canary Islands. Intense solar radiation, remarkable daily temperature variations, long-lasting snow-cover and mechanical disturbances caused by strong winds are usual conditions for this habitat type. Large areas are completely unvegetated or only covered by some bryophytes and lichens or a scattered and, on fragmentary soils, a discontinuous cover of a few, vascular plants.

Appendix C: Crosswalk between the revised EUNIS Habitat Classification for Saltmarshes and Inland habitats with no or little soil and mostly with sparse vegetation and *EuroVegChecklist* 2016

MA211 - Arctic coastal saltmarshes
> JUN-04B - Caricion glareosae Nordhagen 1954
> JUN-04A - Puccinellion phryganodis Hadač 1946

MA221 - Atlantic saltmarsh driftline
<> CAK-01A - Atriplicion littoralis Nordhagen 1940
CAK-01C - Agropyro-Rumicion Nordhagen 1940 nom. ambig. rejic.
<> propos.

MA222 - Atlantic upper saltmarshes
> SAG-01A - Saginion maritimae Westhoff et al. 1962
MOL-10B - Loto tenuis-Trifolion fragiferi Westhoff et Den Held ex de
<> Foucault 2009
JUN-01B - Frankenio laevis-Armerion maritimae Géhu et Géhu-Franck
<> 1975

MA223 - Atlantic upper-mid saltmarshes and saline and brackish reed, rush and sedge beds
<> JUN-03C - Armerion maritimae Br.-Bl. et De Leeuw 1936
<> JUN-01A - Juncion maritimi Br.-Bl. ex Horvatić 1934
<> JUN-03B - Puccinellio maritimae-Spergularion salinae Beeftink 1965
<> PHR-02A - Scirpion maritimi Dahl et Hadač 1941

MA224 - Atlantic mid-low saltmarshes
<> JUN-03A - Festucion maritimae Christiansen 1927
<> SAL-01A - Salicornion fruticosae Br.-Bl. 1933

MA225 - Atlantic pioneer saltmarshes
<> THE-01A - Therosalicornion Br.-Bl. 1933
THE-01B - Salicornion dolichostachyo-fragilis Géhu et Rivas-Mart. ex
> Géhu et Géhu-Franck 1984
> THE-01C - Salicornion ramosissimae Tx. 1974
<> SPA-01A - Spartinion glabrae Conard 1935

MA232 - Baltic coastal meadow
<> JUN-03C - Armerion maritimae Br.-Bl. et De Leeuw 1936
<> JUN-03A - Festucion maritimae Christiansen 1927
MOL-10B - Loto tenuis-Trifolion fragiferi Westhoff et Den Held ex de
<> Foucault 2009
<> PHR-02A - Scirpion maritimi Dahl et Hadač 1941

MA241 - Black Sea littoral saltmarshes

<> JUN-01A - Juncion maritimi Br.-Bl. ex Horvatić 1934
<> FEP-03D - Puccinellion giganteae Dubyna et Neuhäuslová 2000
<> THE-02A - Salicornion prostratae Géhu 1992

MA251 - Mediterranean upper saltmarshes

<> SAG-01B - Spergularion macrorhizae Gamisans 1990
> SAG-01C - Junco ranarii-Plantaginion commutatae Horvatić 1934
> SAG-01D - Romuleo-Saginion (Wolff 1968) Mucina in Mucina et al. 2016
> SAG-01E - Sileno sedoidis-Catapodion loliacei de Foucault et Bioret 2010
> SAL-01C - Suaedion brevifoliae Br.-Bl. et O. de Bolòs 1958

MA252 - Mediterranean upper-mid saltmarshes and saline and brackish reed, rush and sedge beds

< JUN-01A - Juncion maritimi Br.-Bl. ex Horvatić 1934

MA253 - Mediterranean mid-low saltmarshes

> SAL-01B - Arthrocnemion glauci Rivas-Mart. et Costa M. 1984
<> SAL-01A - Salicornion fruticosae Br.-Bl. 1933
<> SPA-01A - Spartinion glabrae Conard 1935
<> THE-01A - Therosalicornion Br.-Bl. 1933

U11 – Cave

x - no relationship

U12 - Disused underground mines and tunnels

x - no relationship

U21 - Boreal and Arctic siliceous scree and block field

> THL-06A - Antitrichio-Rhodiolion roseae Hadač 1971

U22 - Temperate high-mountain siliceous scree

> THL-06B - Androsacion alpinae Br.-Bl. in Br.-Bl. et Jenny 1926
> THL-03B - Androsacion ciliatae Rivas-Mart. 1988
> THL-06E - Dryopteridion oreadis Rivas-Mart. 1977 corr. Rivas-Mart. et al. 1984
> LAM-01A - Chaerophyllion humilis Onipchenko 2002
<> THL-06G - Linario saxatilis-Senecionion carpetani Rivas-Mart. 1964
> THL-06D - Polygono alpini-Poion laxae D. Lakušić et Mucina ined.
> LAM-01B - Scrophulario minimae-Symphyolomion graveolentis Belonovskaya et al. 2014
> THL-06F - Senecionion leucophylli Br.-Bl. 1948
> THL-06C - Veronicion baumgartenii Coldea 1991

U23 - Temperate, lowland to montane siliceous scree

> THL-07A - Galeopsion Oberd. 1957
> THL-07B - Galeopsion pyrenaicae Rivas-Mart. 1977

> PHA-01C - Sesamoidion suffruticosae Ortiz et Pulgar 2000

U24 - Mediterranean siliceous scree

> PHA-01A - Gymnogrammo-Scrophularion Rivas Goday 1964
> THL-06H - Holcion caespitosi Quézel 1953
> THL-06G - Linario saxatilis-Senecionion carpetani Rivas-Mart. 1964
> PHA-01B - Saxifragion continentalis Rivas-Mart. in Rivas-Mart. et al. 1986

U25 - Boreal and Arctic base-rich scree and block field

> THL-01M - Arenarion norvegicae Nordhagen 1935

U26 - Temperate high-mountain base-rich scree and moraine

> THL-04B - Arabidion alpinae Béguin in Richard 1971
> THL-01K - Bunion alpini Lakušić 1968
> THL-03A - Drabion hoppeanae Zollitsch in Merxmüller et Zollitsch 1967
> THL-01D - Iberidion spathulatae Br.-Bl. 1948
> THL-01E - Linarion filicaulis Rivas-Mart. ex Fernández Prieto 1983
> THL-01B - Papaverion tatrici Pawłowski et al. 1928 corr. Valachovič 1995
> THL-01C - Papavero-Thymion pulcherrimi Pop 1968
> THL-04C - Petasition doerfleri Lakušić 1968
> THL-04A - Petasition paradoxi Zollitsch ex Lippert 1966
> THL-01F - Saxifragion praetermissae Rivas-Mart. 1977
> THL-01J - Saxifragion prenjae Lakušić 1968
> THL-01A - Thlaspion rotundifolii Jenny-Lips 1930
> THL-01L - Veronico-Papaverion degenii Mucina et al. 1990

U27 - Temperate, lowland to montane base-rich scree

> THL-05B - Leontodontion hyoseroidis Duvigneaud et al. 1970
> DRY-01A - Peltarion alliaceae Horvatić in Domac 1957
> THL-05C - Stipion calamagrostis Jenny-Lips ex Br.-Bl. 1950

U28 - Western Mediterranean base-rich scree

> PHA-01F - Andryalion ragusinae Rivas Goday et Esteve 1972
> DRY-03B - Arrhenatherion sardoi Gamisans 1989
<> PHA-01E - Calendulo lusitanicae-Antirrhinion linkiani Ladero et al. 1991
> THL-01H - Festucion dimorphae Bonin 1978
> DRY-03A - Linarion purpureae S. Brullo 1984
<> PHA-01D - Melico minutae-Phagnalion intermedii Rivas Goday et Esteve 1972
> THL-05A - Pimpinello tragium-Gouffeion arenarioidis Br.-Bl. in Br.-Bl. et al. 1952
> THL-01G - Platycapno saxicolae-Iberidion granatensis Rivas Goday et Rivas-Mart. 1963
> DRY-03C - Ptilostemono casabonae-Euphorbion cupanii Angiolini et al. 2005
> THL-09B - Scrophularion sciophilae O. de Bolòs 1957

> THL-01I - Thlaspion stylosi Feoli-Chiapella et Feoli 1977

U29 - Eastern Mediterranean base-rich scree

> DRY-01F - Alysso sphaciotici-Valantion apricae Bergmeier 2002
> DRY-01E - Campanulion hawkinsianae Quézel 1967
> DRY-01D - Silenion caesiae Quézel 1964
> DRY-01B - Silenion marginatae Lakušić 1968

U2A - Crimean base-rich screes

> DRY-02C - Austrodauco-Salvion verticillati Korzhenevskii et Kliukin 1990
> DRY-01C - Rumici scutati-Heracleion stevenii Ryff 2007

U31 - Boreal and Arctic siliceous inland cliff

> ASP-11B - Allosuro-Athyrion alpestris Nordhagen 1943
> ASP-11A - Saxifragion cotyledonis Nordhagen ex Mucina et Chytrý in Mucina et al. 2016

U32 - Temperate high-mountain siliceous inland cliff

> ASP-11C - Androsacion vandellii Br.-Bl. in Br.-Bl. et Jenny 1926 nom. corr.
> ASP-11G - Gypsophilion tenuifoliae Onipchenko 2002
> ASP-11E - Saxifragion cymosae Lakušić 1970
> ASP-11D - Saxifragion pedemontanae Barbero et Bono 1967
> ASP-11F - Silenion lerchenfeldianae Simon 1958

U33 - Temperate, lowland to montane siliceous inland cliff

> ASP-12A - Antirrhinion asarinae (Br.-Bl. in Meier et Br.-Bl. 1934) Br.-Bl. in Br.-Bl. et al. 1952
<> ASP-01A - Asplenio scolopendrii-Geranion robertiani Ferrez 2010
> ASP-10B - Asplenion septentrionalis Gams in Oberd. 1938
<> POD-02C - Hymenophyllion tunbrigensis Tx. in Tx. et Oberd. 1958
> POD-01A - Hypno-Polypodion vulgaris Mucina 1993
<> POD-05B - Rupicampanulion Rothmaler 1954
> ASP-10E - Thalictro foetidi-Asplenion Onipchenko et Gorbachevskaya in Onipchenko 2002 (Biul. Mosk. Obshch. Ispyt. Prir., Otd. Biol.)
<> POD-05A - Valeriano longifoliae-Petrocoptidion Fernández Casas 1972

U34 - Mediterranean siliceous inland cliff

> ASP-12C - Asplenio billotii-Dianthion godroniani Rameau 1996 nom. inval.
> ASP-12E - Dianthion rupicolae S. Brullo et Marcenò 1979
> ASP-11H - Hieracion carpetani González-Albo 1941
> ASP-12B - Cheilanthion hispanicae Rivas Goday et al. 1956
> ASP-12D - Linarion caprariae Foggi et al. 2006
> ASP-10D - Pohlio crudae-Asplenion septentrionalis S. Brullo et Siracusa in S. Brullo et al. 2001
> ASP-13C - Polygonion icarici Horvat in Horvat, Glavač et Ellenberg ex Bergmeier et al. 2011

<> POD-02A - Polypodion serrati Br.-Bl. in Br.-Bl. et al. 1952
> ASP-11J - Potentillion crassinerviae Gamisans 1975
> ASP-11I - Saxifragion nevadensis Rivas Goday et Rivas-Mart. 1971

U35 - Boreal and Arctic base-rich inland cliff

= POD-04B - Cochlearion alpinae Br.-Bl. in Br.-Bl. 1952

U36 - Temperate high-mountain base-rich inland cliff

> ASP-03B - Amphoricarpion neumayeri Lakušić 1968
> ASP-02H - Asplenio celtiberici-Saxifragion cuneatae Rivas-Mart. in Loidi et Fernández Prieto 1986
> ASP-02I - Drabion hispanicae Font Quer 1935
> ASP-03C - Edraiantho graminifolii-Erysimion comati Mucina et al. 1990
> ASP-02E - Gypsophilion petraeae Borhidi et Pócs in Borhidi 1958
> ASP-02L - Micromerion croaticae Horvat in Blečić 1959
> ASP-02D - Micromerion pulegii Boşcaiu (1971) 1979
> ASP-03 - Moltkeetalia petraeae Lakušić 1968
> ASP-02B - Physoplexido comosae-Saxifragion petraeae Mucina et Theurillat 2015
> ASP-02A - Potentillion caulescentis Br.-Bl. In Br.-Bl. et Jenny 1926
> ASP-02K - Saxifragion australis Biondi et Ballelli ex S. Brullo 1984
> ASP-02C - Saxifragion lingulatae (Rioux et Quézel 1949) Quézel 1950
> ASP-02F - Saxifragion mediae Br.-Bl. in Meier et Br.-Bl. 1934
> ASP-02G - Sedo albi-Seslerion hispanicae Br.-Bl. 1966
> POD-04A - Violo biflorae-Cystopteridion alpinae Fernández Casas 1970

U37 - Temperate, lowland to montane base-rich inland cliff

<> ASP-01A - Asplenio scolopendrii-Geranion robertiani Ferrez 2010
> POD-03A - Ctenidio-Polypodion vulgaris S. Brullo et al. 2001
> ASP-01B - Drabo cuspidatae-Campanulion tauricae Ryff 2000
> ASP-03A - Edraianthion Lakušić 1968
<> POD-02C - Hymenophyllion tunbrigensis Tx. in Tx. et Oberd. 1958
> POD-03B - Moehringion muscosae Horvat et Horvatić ex Boşcaiu, Gergely et Codoreanu in Raţiu et al. 1966
> POD-03C - Polysticho setiferi-Phyllitidion scolopendrii Ubaldi ex Ubaldi et Biondi in Biondi et al. 2014
<> POD-05B - Rupicampanulion Rothmaler 1954
<> POD-05A - Valeriano longifoliae-Petrocoptidion Fernández Casas 1972

U38 - Mediterranean base-rich inland cliff

> POD-02B - Arenarion balearicae O. de Bolòs et Molinier 1969
> ASP-04D - Arenarion bertolonii Gamisans ex Theurillat in Mucina et al. 2015
> ASP-09E - Arenarion creticae Dimopoulos et al. ex Bergmeier 2002
<> CYM-01C - Artemisio arborescentis-Capparidion spinosae Biondi, Blasi et Galdenzi in Biondi et al. 2014
> ASP-05C - Asperulion garganicae Bianco et al. 1989
> ASP-04A - Asplenion glandulosi Br.-Bl. in Meier et Br.-Bl. 1934

> ASP-07B - Asterion cretici Zaffran ex Bergmeier et al. 2011
> ASP-04B - Brassicion insularis Gamisans 1991
> ASP-04E - Brassico balearicae-Helichrysion rupestris O. de Bolòs et Molinier 1958
<> PHA-01E - Calendulo lusitanicae-Antirrhinion linkiani Ladero et al. 1991
> ASP-04G - Campanulion velutinae Martínez-Parras et Peinado Lorca 1990
> ASP-06A - Campanulion versicoloris Quézel 1964
> ASP-07C - Capparo-Amaracion tournefortii Horvat in Horvat, Glavač et Ellenberg ex Bergmeier et al. 2011
> ASP-06B - Caro multiflori-Aurinion megalocarpae Terzi et D'Amico 2008
> ASP-05B - Centaureo cuspidatae-Portenschlagiellion ramosissimae Trinajstić ex Terzi et Di Pietro 2016
> ASP-05A - Centaureo dalmaticae-Campanulion Horvatić 1934
> ASP-04C - Centaureo filiformis-Micromerion cordatae Arrigoni et Di Tommaso 1991
> ASP-04H - Cosentinio bivalentis-Lafuenteion rotundifoliae Asensi et al. 1990
<> CYM-01B - Galio valantiae-Parietarion judaicae Rivas-Mart. ex O. de Bolòs 1967
> ASP-09A - Galion degenii Quézel 1967
> ASP-07D - Inulion heterolepidis Horvat ex Bergmeier et al. 2011
<> PHA-01D - Melico minutae-Phagnalion intermedii Rivas Goday et Esteve 1972
<> CYM-01D - Parietario judaicae-Hyoscyamion aurei S. Brullo et Guarino 1999
> ASP-07A - Petromarulo-Centaurion argenteae Horvat in Horvat, Glavač et Ellenberg ex Bergmeier et al. 2011
<> POD-02A - Polypodion serrati Br.-Bl. in Br.-Bl. et al. 1952
> ASP-09B - Ramondion nathaliae Horvat ex Simon 1958
> ASP-08A - Sarcocapnion enneaphyllae Fernández Casas 1972
> ASP-08B - Sarcocapnion pulcherrimae Fernández Casas 1972 corr. Rivas-Mart. et al. 2002
> ASP-02J - Saxifragion camposii Cuatrecasas ex Quézel 1953
> ASP-09C - Saxifragion scardicae Dimopoulos et al. 1997
> ASP-09D - Silenion auriculatae Quézel 1964
> ASP-04F - Teucrion buxifolii Rivas Goday 1956

U39 - Boreal ultramafic inland cliff

< ASP-10C - Asplenion serpentini Br.-Bl. et Tx. ex Eggler 1955

U3A - Temperate ultramafic inland cliff

< ASP-10C - Asplenion serpentini Br.-Bl. et Tx. ex Eggler 1955

U3B - Mediterranean ultramafic inland cliff

= ASP-13B - Phagnalo saxatilis-Cheilanthion maderensis Loisel 1970 corr. Pérez-Carro et al. 1989

U3C - Macaronesian inland cliff

> ASP-13A - Cheilanthion pulchellae Sáenz de Rivas et Rivas-Mart. 1979
POD-02D - Thelipterido pozoi-Woodwardion radicantis Fernández Prieto
> et Aguiar in Fernández Prieto et al. 2012

U3D - Wet inland cliff

> ADI-01A - Adiantion Br.-Bl. ex Horvatić 1934
> ADI-01B - Pinguiculion longifoliae Fernández Casas 1970

U3E - Limestone pavement

x - no relationship

U41 - Snow pack

x - no relationship

U42 - Ice cap and glacier

x - no relationship

U43 - Rock glacier and unvegetated ice-dominated moraine

x - no relationship

U51 - Fjell field

x - no relationship

U52 - Polar desert

PAP-01A - Papaverion dahliani Hofmann ex Daniëls, Elvebakk et
= Matveyeva in Daniëls et al. 2016

U53 - Glacial moraines with very sparse or no vegetation

x - no relationship

U61 - SubArctic volcanic field

x - no relationship

U62 - Mediterranean, Macaronesian and temperate volcanic field

<> RUM-01A - Rumici-Astragalion siculi Poli 1965
VIO-01A - Violion cheiranthifoliae Voggenreiter ex Martín Osorio,
<> Wildpret et Rivas-Mart. in Martín Osorio et al. 2007

Appendix E: Characteristic species combinations of the revised EUNIS Habitat Classification for Inland habitats with no or little soil and mostly with sparse vegetation

MA211 - Arctic coastal saltmarshes

*Diagnostic species (phi coefficient * 100)*

Stellaria humifusa	63.5	Carex subspathacea	63.4
Puccinellia phryganodes	61.6	Carex glareosa	50.7
Argentina anserina subsp. groenlandica	48.5	Bryum salinum	43.3
Calamagrostis deschampsioides	42.7	Carex mackenziei	35.7
Dupontia fisheri	34.1	Carex salina	31.7
Arctanthemum arcticum	31.7	Sanionia uncinata	22.3
Gentianella detonsa	21.4	Cephaloziella grimsulana	21.4
Salix reptans	18.3	Carex ursina	18.2
Euphrasia hyperborea	17.8	Festuca richardsonii	17.7
Primula nutans	17.4	Stellaria crassifolia	17.3
Mycobilimbia hypnorum	17.0	Stereocaulon glareosum	16.8
Tripleurospermum hookeri	15.8		

Constant species (occurrence frequencies)

Stellaria humifusa	42.0	Carex subspathacea	42.0
Puccinellia phryganodes	38.0	Festuca rubra aggr.	32.0
Sanionia uncinata	28.0	Carex glareosa	28.0
Agrostis stolonifera	27.0	Argentina anserina subsp. groenlandica	25.0
Plantago maritima	23.0	Triglochin maritima	20.0
Calamagrostis deschampsioides	20.0	Bryum salinum	20.0
Parnassia palustris	18.0	Dupontia fisheri	15.0
Carex mackenziei	13.0	Carex salina	12.0
Arctanthemum arcticum	12.0		

Dominant species (percentage frequencies of occurrences with cover > 25%)

Carex subspathacea	28.0	Puccinellia phryganodes	13.0
Stellaria humifusa	12.0	Sanionia uncinata	10.0
Carex salina	7.0	Carex glareosa	7.0
Salix reptans	5.0	Festuca richardsonii	5.0

MA221 - Atlantic saltmarsh driftline

*Diagnostic species (phi coefficient * 100)*

Atriplex littoralis	40.5	Atriplex prostrata	34.7
Oxybasis rubra	31.5	Artemisia maritima	30.1

Tripleurospermum maritimum aggr.	22.9	Elytrigia repens aggr.	21.0
Elytrigia atherica	19.8	Rumex crispus	17.5
Suaeda maritima aggr.	15.8	Sonchus arvensis	15.6

Constant species (occurrence frequencies)

Atriplex prostrata	76.0	Elytrigia repens aggr.	73.0
Tripleurospermum maritimum aggr.	47.0	Atriplex littoralis	44.0
Rumex crispus	36.0	Agrostis stolonifera	33.0
Oxybasis rubra	29.0	Suaeda maritima aggr.	27.0
Festuca rubra aggr.	27.0	Elytrigia atherica	27.0
Sonchus arvensis	24.0	Tripolium pannonicum	20.0
Cirsium arvense	20.0	Artemisia maritima	20.0
Argentina anserina	20.0	Bolboschoenus maritimus	18.0
Senecio vulgaris	16.0	Polygonum aviculare aggr.	13.0
Phragmites australis	13.0	Oxybasis glauca	11.0
Elytrigia juncea	11.0	Chenopodium album aggr.	11.0

Dominant species (percentage frequencies of occurrences with cover > 25%)

Elytrigia repens aggr.	33.0	Oxybasis rubra	16.0
Atriplex littoralis	13.0	Tripleurospermum maritimum aggr.	11.0
Elytrigia atherica	7.0		

MA222 - Atlantic upper saltmarshes

*Diagnostic species (phi coefficient * 100)*

Juncus gerardi	28.8	Trifolium fragiferum	25.6
Glaux maritima	23.5	Cochlearia danica	21.1
Carex distans	20.9	Armeria maritima	20.4
Trifolium repens	20.3	Agrostis stolonifera	19.9
Plantago coronopus aggr.	19.8	Festuca rubra aggr.	17.6
Argentina anserina	16.3		

Constant species (occurrence frequencies)

Festuca rubra aggr.	77.0	Agrostis stolonifera	75.0
Trifolium repens	61.0	Juncus gerardi	55.0
Plantago coronopus aggr.	45.0	Glaux maritima	37.0
Armeria maritima	37.0	Trifolium fragiferum	34.0
Argentina anserina	33.0	Plantago maritima	30.0
Carex distans	29.0	Scorzoneroides autumnalis	26.0
Lotus tenuis	20.0	Holcus lanatus	20.0
Lolium perenne	19.0	Poa pratensis aggr.	18.0
Cerastium fontanum subsp. vulgare	18.0	Cochlearia danica	16.0
Centaurium pulchellum	16.0	Plantago major	14.0
Lotus corniculatus	14.0	Odontites vulgaris aggr.	13.0
Leontodon saxatilis	13.0	Juncus articulatus	13.0
Triglochin maritima	12.0	Sagina maritima	12.0
Poa trivialis	12.0	Plantago lanceolata	12.0

Phragmites australis	12.0	Elytrigia repens aggr.	12.0
Bellis perennis	12.0	Oenanthe lachenalii	11.0

Dominant species (percentage frequencies of occurrences with cover > 25%)

Festuca rubra aggr.	42.0	Agrostis stolonifera	25.0
Trifolium repens	10.0	Juncus gerardi	10.0
Plantago coronopus aggr.	9.0		

MA223 - Atlantic upper-mid saltmarshes and saline and brackish reed, rush and sedge beds

*Diagnostic species (phi coefficient * 100)*

Glaux maritima	33.9	Plantago maritima	26.2
Cochlearia officinalis	25.8	Armeria maritima	22.9
Tripolium pannonicum	21.1	Juncus gerardi	20.2
Artemisia maritima	18.6	Triglochin maritima	16.1
Spergularia media	15.7	Elytrigia atherica	15.1

Constant species (occurrence frequencies)

Festuca rubra aggr.	63.0	Plantago maritima	56.0
Glaux maritima	54.0	Agrostis stolonifera	50.0
Tripolium pannonicum	43.0	Armeria maritima	41.0
Juncus gerardi	39.0	Triglochin maritima	28.0
Atriplex prostrata	26.0	Elytrigia atherica	21.0
Cochlearia officinalis	20.0	Spergularia media	19.0
Puccinellia maritima	19.0	Juncus maritimus	17.0
Plantago coronopus aggr.	16.0	Bolboschoenus maritimus	14.0
Artemisia maritima	12.0	Carex extensa	11.0

Dominant species (percentage frequencies of occurrences with cover > 25%)

Festuca rubra aggr.	33.0	Juncus gerardi	14.0
Agrostis stolonifera	11.0	Plantago maritima	10.0
Juncus maritimus	9.0	Elytrigia atherica	9.0
Glaux maritima	7.0		

MA224 - Atlantic mid-low saltmarshes

*Diagnostic species (phi coefficient * 100)*

Puccinellia maritima	66.6	Spergularia media	33.6
Salicornia europaea aggr.	32.8	Tripolium pannonicum	30.7
Suaeda maritima aggr.	29.9	Halimione portulacoides	26.8
Limonium humile	26.6	Limonium vulgare	19.5
Cochlearia anglica	18.3	Triglochin maritima	17.8
Glaux maritima	16.9	Plantago maritima	16.3

Constant species (occurrence frequencies)

Puccinellia maritima	86.0	Tripolium pannonicum	62.0
Salicornia europaea aggr.	53.0	Suaeda maritima aggr.	49.0
Spergularia media	40.0	Halimione portulacoides	39.0
Plantago maritima	36.0	Triglochin maritima	31.0
Glaux maritima	27.0	Limonium vulgare	19.0
Armeria maritima	19.0	Spartina anglica	14.0
Festuca rubra aggr.	11.0	Atriplex prostrata	11.0

Dominant species (percentage frequencies of occurrences with cover > 25%)

Puccinellia maritima	47.0	Halimione portulacoides	14.0
Salicornia europaea aggr.	10.0	Suaeda maritima aggr.	9.0
Plantago maritima	6.0		

MA225 - Atlantic pioneer saltmarshes

*Diagnostic species (phi coefficient * 100)*

Spartina anglica	78.7	Salicornia stricta	33.8
Spartina maritima	28.9	Salicornia europaea aggr.	26.5
Puccinellia maritima	24.6	Suaeda maritima aggr.	22.7
Spartina alterniflora	16.8	Tripolium pannonicum	15.4

Constant species (occurrence frequencies)

Spartina anglica	75.0	Salicornia europaea aggr.	43.0
Suaeda maritima aggr.	38.0	Tripolium pannonicum	32.0
Puccinellia maritima	32.0	Salicornia stricta	14.0
Halimione portulacoides	13.0	Spartina maritima	11.0

Dominant species (percentage frequencies of occurrences with cover > 25%)

Spartina anglica	53.0	Spartina maritima	8.0
Salicornia europaea aggr.	8.0	Salicornia stricta	7.0

MA232 - Baltic coastal meadow

*Diagnostic species (phi coefficient * 100)*

Eleocharis uniglumis	44.7	Juncus gerardi	40.8
Glaux maritima	40.4	Triglochin maritima	37.2
Trifolium fragiferum	29.3	Blysmopsis rufa	25.9
Argentina anserina	24.5	Plantago maritima	22.2
Agrostis stolonifera	22.2	Eleocharis parvula	21.5
Triglochin palustris	19.4	Centaurium littorale	16.1
Scorzoneroides autumnalis	15.6		

Constant species (occurrence frequencies)

Agrostis stolonifera	83.0	Juncus gerardi	78.0
Triglochin maritima	64.0	Glaux maritima	64.0
Plantago maritima	48.0	Festuca rubra aggr.	48.0

Argentina anserina	48.0	Eleocharis uniglumis	47.0
Phragmites australis	43.0	Trifolium fragiferum	39.0
Triglochin palustris	29.0	Scorzoneroides autumnalis	27.0
Plantago major	27.0	Bolboschoenus maritimus	23.0
Trifolium repens	18.0	Poa pratensis aggr.	18.0
Elytrigia repens aggr.	18.0	Tripolium pannonicum	17.0
Schoenoplectus lacustris subsp. glaucus	16.0	Juncus articulatus	16.0
Spergularia marina	14.0	Puccinellia distans	14.0
Lotus tenuis	14.0	Carex distans	14.0
Schedonorus arundinaceus	13.0	Centaurium littorale	12.0

Dominant species (percentage frequencies of occurrences with cover > 25%)

Juncus gerardi	31.0	Agrostis stolonifera	29.0
Festuca rubra aggr.	18.0	Plantago maritima	10.0

MA241 - Black Sea littoral saltmarshes

*Diagnostic species (phi coefficient * 100)*

Limonium meyeri	38.5	Artemisia santonicum	34.2
Halimione verrucifera	32.9	Halimione pedunculata	23.8
Elytrigia elongata	22.5	Limonium bellidifolium	22.1
Salicornia europaea aggr.	20.2	Puccinellia distans	20.2
Aeluropus littoralis	16.9	Puccinellia dolicholepis	16.7
Juncus gerardi	15.4	Suaeda maritima aggr.	15.1

Constant species (occurrence frequencies)

Artemisia santonicum	59.0	Limonium meyeri	55.0
Salicornia europaea aggr.	33.0	Juncus gerardi	30.0
Puccinellia distans	29.0	Halimione verrucifera	28.0
Elytrigia elongata	28.0	Suaeda maritima aggr.	26.0
Phragmites australis	23.0	Tripolium pannonicum	22.0
Elytrigia repens aggr.	19.0	Atriplex prostrata	18.0
Cynanchum acutum	15.0	Bromus squarrosus	15.0
Aeluropus littoralis	15.0	Limonium bellidifolium	14.0
Spergularia marina	11.0	Halimione pedunculata	11.0

Dominant species (percentage frequencies of occurrences with cover > 25%)

Artemisia santonicum	13.0	Elytrigia elongata	9.0
Juncus gerardi	8.0	Salicornia europaea aggr.	6.0
Puccinellia distans	6.0		

MA251 - Mediterranean upper saltmarshes

*Diagnostic species (phi coefficient * 100)*

Parapholis incurva	52.4	Arthrocnemum macrostachyum	27.0

Hordeum marinum	26.9	Parapholis filiformis	26.2
Polypogon subspathaceus	24.7	Plantago coronopus aggr.	24.7
Spergularia marina	24.0	Frankenia pulverulenta	22.7
Sphenopus divaricatus	20.1	Spergularia heldreichii	19.0
Spergularia macrorrhiza	18.8	Sagina maritima	16.4

Constant species (occurrence frequencies)

Parapholis incurva	59.0	Plantago coronopus aggr.	56.0
Spergularia marina	30.0	Arthrocnemum macrostachyum	24.0
Hordeum marinum	23.0	Parapholis filiformis	20.0
Halimione portulacoides	19.0	Sagina maritima	14.0
Frankenia pulverulenta	14.0	Polypogon subspathaceus	13.0
Polypogon monspeliensis	13.0	Juncus bufonius aggr.	13.0
Sphenopus divaricatus	12.0	Spergularia media	12.0
Puccinellia festuciformis	12.0	Atriplex prostrata	12.0

Dominant species (percentage frequencies of occurrences with cover > 25%)

Parapholis incurva	24.0	Spergularia marina	10.0
Parapholis filiformis	10.0	Arthrocnemum macrostachyum	8.0
Plantago coronopus aggr.	7.0		

MA252 - Mediterranean upper-mid saltmarshes and saline and brackish reed rush and sedge beds

*Diagnostic species (phi coefficient * 100)*

Juncus acutus	41.2	Juncus maritimus	30.8
Limbarda crithmoides	28.9	Limonium narbonense	26.9
Juncus subulatus	23.6	Carex extensa	20.8
Sarcocornia fruticosa	19.6	Bolboschoenus maritimus	18.7
Plantago crassifolia	17.0		

Constant species (occurrence frequencies)

Juncus acutus	52.0	Phragmites australis	46.0
Juncus maritimus	46.0	Limbarda crithmoides	37.0
Bolboschoenus maritimus	37.0	Tripolium pannonicum	29.0
Atriplex prostrata	23.0	Halimione portulacoides	22.0
Sarcocornia fruticosa	20.0	Limonium narbonense	20.0
Carex extensa	20.0	Dittrichia viscosa	16.0
Elytrigia atherica	15.0	Juncus subulatus	13.0
Sonchus maritimus	12.0	Plantago crassifolia	12.0
Aeluropus littoralis	11.0		

Dominant species (percentage frequencies of occurrences with cover > 25%)

Juncus acutus	23.0	Bolboschoenus maritimus	15.0
Juncus maritimus	12.0	Phragmites australis	7.0
Limbarda crithmoides	6.0	Halimione portulacoides	6.0

MA253 - Mediterranean mid-low saltmarshes

*Diagnostic species (phi coefficient * 100)*

Sarcocornia fruticosa	44.4	Halimione portulacoides	34.0
Puccinellia festuciformis	33.3	Arthrocnemum macrostachyum	31.0
Sarcocornia perennis	28.6	Limonium narbonense	27.1
Limbarda crithmoides	24.0	Artemisia caerulescens	23.6
Spartina versicolor	23.3	Limoniastrum monopetalum	19.5
Aeluropus littoralis	18.0	Limonium girardianum	16.1
Suaeda maritima aggr.	15.8	Limonium vulgare	15.8
Juncus maritimus	15.2		

Constant species (occurrence frequencies)

Halimione portulacoides	50.0	Sarcocornia fruticosa	44.0
Limbarda crithmoides	30.0	Arthrocnemum macrostachyum	28.0
Suaeda maritima aggr.	27.0	Puccinellia festuciformis	27.0
Juncus maritimus	23.0	Salicornia europaea aggr.	21.0
Limonium narbonense	20.0	Sarcocornia perennis	19.0
Artemisia caerulescens	17.0	Limonium vulgare	16.0
Aeluropus littoralis	16.0	Spartina versicolor	13.0
Tripolium pannonicum	11.0		

Dominant species (percentage frequencies of occurrences with cover > 25%)

Sarcocornia fruticosa	24.0	Spartina versicolor	11.0
Halimione portulacoides	9.0	Salicornia europaea aggr.	7.0
Arthrocnemum macrostachyum	7.0	Sarcocornia perennis	6.0
Limoniastrum monopetalum	6.0		

U21 - Boreal and Arctic siliceous scree and block field

*Diagnostic species (phi coefficient * 100)*

Trisetum spicatum	42.2	Calamagrostis lapponica	36.8
Antennaria alpina	34.6	Carex bigelowii	33.4
Hieracium lachenalii	32.6	Astragalus alpinus	31.5
Agrostis mertensii	31.0	Viola biflora	30.3
Cassiope hypnoides	28.1	Gnaphalium supinum	27.9
Sibbaldia procumbens	24.3	Festuca ovina	23.0
Carex lachenalii	22.7	Botrychium boreale	22.1
Salix herbacea	21.3	Bistorta vivipara	20.8
Solidago virgaurea	20.4	Oxyria digyna	20.4
Rhodiola rosea	20.1	Saussurea alpina aggr.	19.5
Salix glauca	18.7	Juncus trifidus	17.1
Potentilla crantzii	16.5	Viola epipsila	16.4
Saxifraga nivalis	16.0	Veronica alpina	15.9
Minuartia biflora	15.7	Saxifraga rivularis	15.4
Pyrola minor	15.2	Vaccinium vitis-idaea	15.1

Constant species (occurrence frequencies)

Festuca ovina	80.0	Viola biflora	65.0
Solidago virgaurea	65.0	Vaccinium vitis-idaea	60.0
Carex bigelowii	60.0	Bistorta vivipara	55.0
Anthoxanthum odoratum aggr.	55.0	Hieracium lachenalii	50.0
Avenella flexuosa	50.0	Salix herbacea	40.0
Gnaphalium supinum	40.0	Calamagrostis lapponica	40.0
Trisetum spicatum	35.0	Campanula rotundifolia	35.0
Antennaria alpina	35.0	Sibbaldia procumbens	30.0
Saussurea alpina aggr.	30.0	Juncus trifidus	30.0
Trientalis europaea	25.0	Oxyria digyna	25.0
Linnaea borealis	25.0	Cassiope hypnoides	25.0
Astragalus alpinus	25.0	Agrostis mertensii	25.0
Veronica alpina	20.0	Vaccinium myrtillus	20.0
Selaginella selaginoides	20.0	Salix glauca	20.0
Rhodiola rosea	20.0	Ranunculus acris aggr.	20.0
Potentilla crantzii	20.0	Luzula campestris aggr.	20.0
Juniperus communis subsp. nana	20.0	Thalictrum alpinum	15.0
Pyrola minor	15.0	Poa alpina	15.0
Luzula spicata	15.0	Luzula pilosa	15.0
Geranium sylvaticum aggr.	15.0	Deschampsia cespitosa aggr.	15.0
Carex vaginata	15.0	Carex lachenalii	15.0

Dominant species (percentage frequencies of occurrences with cover > 25%)

U22 - Temperate high-mountain siliceous scree

*Diagnostic species (phi coefficient * 100)*

Saxifraga bryoides	31.5	Poa laxa	29.9
Ranunculus glacialis	28.0	Veronica telephiifolia	23.1
Oxyria digyna	21.6	Leucanthemopsis alpina	18.4
Cardamine resedifolia	18.2	Androsace alpina	17.8
Murbeckiella pinnatifida	17.0	Geum reptans	16.8
Saxifraga seguieri	15.8	Sedum alpestre	15.6
Saxifraga sibirica	15.6	Cerastium uniflorum	15.4

Constant species (occurrence frequencies)

Oxyria digyna	26.0	Saxifraga bryoides	25.0
Poa alpina	23.0	Ranunculus glacialis	20.0
Leucanthemopsis alpina	20.0	Poa laxa	19.0
Cardamine resedifolia	16.0	Sedum alpestre	14.0
Linaria alpina	14.0	Silene acaulis	12.0
Luzula alpinopilosa	12.0	Cryptogramma crispa	12.0

Dominant species (percentage frequencies of occurrences with cover > 25%)

U23 - Temperate, lowland to montane siliceous scree

*Diagnostic species (phi coefficient * 100)*

Galeopsis segetum	41.7	Digitalis purpurea	28.6
Senecio viscosus	26.1	Linaria repens	17.7

Constant species (occurrence frequencies)

Digitalis purpurea	43.0	Avenella flexuosa	31.0
Rumex acetosella	23.0	Galeopsis segetum	23.0
Senecio viscosus	19.0	Campanula rotundifolia	18.0
Linaria repens	17.0	Cytisus scoparius	17.0
Teucrium scorodonia	15.0	Pilosella officinarum	14.0
Agrostis capillaris	14.0	Galeopsis tetrahit aggr.	11.0
Festuca ovina	11.0		

Dominant species (percentage frequencies of occurrences with cover > 25%)

U24 - Mediterranean siliceous scree

*Diagnostic species (phi coefficient * 100)*

Viola crassiuscula	22.9	Chaenorhinum glareosum	22.9
Cryptogramma crispa	22.7	Festuca clementei	21.8
Biscutella glacialis	20.4	Viola argenteria	17.0
Euphorbia nevadensis	16.7	Arenaria pungens	16.3
Silene inaperta	16.2	Reseda complicata	15.3
Stachys corsica	15.0		

Constant species (occurrence frequencies)

Digitalis purpurea	21.0	Cryptogramma crispa	19.0
Avenella flexuosa	16.0		

Dominant species (percentage frequencies of occurrences with cover > 25%)

U25 - Boreal and Arctic base-rich scree and block field

*Diagnostic species (phi coefficient * 100)*

Saussurea alpina aggr.	49.6	Thalictrum alpinum	29.5
Selaginella selaginoides	29.1	Tofieldia pusilla	27.5
Bistorta vivipara	24.7	Juncus biglumis	23.1
Betula nana	21.0	Viola biflora	20.7
Potentilla nivea	20.6	Arenaria pseudofrigida	19.8
Carex stenolepis	19.6	Antennaria alpina	19.6
Salix reticulata	19.3	Draba norvegica	19.1
Erigeron uniflorus	18.9	Pedicularis palustris	18.2
Salix polaris	17.9	Vahlodea atropurpurea	17.6

Trichophorum alpinum	17.0	Rhinanthus groenlandicus	16.7
Cassiope hypnoides	16.7	Carex bigelowii	16.3
Cardamine bellidifolia	15.4	Carex lachenalii	15.0

Constant species (occurrence frequencies)

Saussurea alpina aggr.	75.0	Bistorta vivipara	65.0
Selaginella selaginoides	50.0	Festuca ovina	50.0
Viola biflora	45.0	Betula nana	45.0
Vaccinium vitis-idaea	40.0	Thalictrum alpinum	40.0
Vaccinium uliginosum	35.0	Ranunculus acris aggr.	35.0
Solidago virgaurea	30.0	Equisetum palustre	30.0
Empetrum nigrum aggr.	30.0	Carex bigelowii	30.0
Andromeda polifolia	30.0	Tofieldia pusilla	25.0
Potentilla erecta	25.0	Geranium sylvaticum aggr.	25.0
Aulacomnium palustre	25.0	Salix reticulata	20.0
Poa alpina	20.0	Pinguicula vulgaris	20.0
Picea abies	20.0	Pedicularis palustris	20.0
Parnassia palustris	20.0	Molinia caerulea aggr.	20.0
Deschampsia cespitosa aggr.	20.0	Bartsia alpina	20.0
Avenella flexuosa	20.0	Antennaria dioica	20.0
Antennaria alpina	20.0	Vaccinium myrtillus	15.0
Trichophorum cespitosum	15.0	Trichophorum alpinum	15.0
Saxifraga oppositifolia	15.0	Salix polaris	15.0
Salix herbacea	15.0	Phyllodoce caerulea	15.0
Nardus stricta	15.0	Melampyrum pratense	15.0
Juncus biglumis	15.0	Huperzia selago	15.0
Hieracium lachenalii	15.0	Filipendula ulmaria	15.0
Eriophorum angustifolium	15.0	Erigeron uniflorus	15.0
Equisetum arvense	15.0	Dryas octopetala	15.0
Comarum palustre	15.0	Cassiope hypnoides	15.0
Carex rostrata	15.0	Carex lasiocarpa	15.0
Carex capillaris	15.0	Campanula rotundifolia	15.0
Anthoxanthum odoratum aggr.	15.0		

Dominant species (percentage frequencies of occurrences with cover > 25%)

U26 - Temperate high-mountain base-rich scree and moraine

*Diagnostic species (phi coefficient * 100)*

Linaria alpina	32.9	Noccaea rotundifolia	24.9
Hornungia alpina	24.7	Galium megalospermum	23.8
Cerastium latifolium	23.3	Trisetum distichophyllum	19.1
Saxifraga oppositifolia	18.7	Moehringia ciliata	18.7
Cerastium carinthiacum	18.2	Doronicum grandiflorum	17.3
Crepis pygmaea	17.1	Scorzoneroides montana	15.5
Viola cenisia	15.1		

Constant species (occurrence frequencies)

Linaria alpina	32.0	Saxifraga oppositifolia	27.0
Hornungia alpina	24.0	Poa alpina	22.0
Arabis alpina	20.0	Campanula cochleariifolia	16.0
Noccaea rotundifolia	14.0	Silene vulgaris	13.0
Rumex scutatus	13.0	Saxifraga aizoides	12.0
Myosotis alpestris	12.0	Silene acaulis	11.0

Dominant species (percentage frequencies of occurrences with cover > 25%)

U27 - Temperate, lowland to montane base-rich scree

*Diagnostic species (phi coefficient * 100)*

Microrrhinum minus	19.3	Galeopsis angustifolia	17.5

Constant species (occurrence frequencies)

Euphorbia seguieriana	18.0	Vincetoxicum hirundinaria	16.0
Microrrhinum minus	14.0	Galeopsis angustifolia	14.0
Euphorbia cyparissias	11.0		

Dominant species (percentage frequencies of occurrences with cover > 25%)

U28 - Western Mediterranean base-rich scree

*Diagnostic species (phi coefficient * 100)*

Galeopsis angustifolia	18.3	Ptychotis saxifraga	16.2
Erodium daucoides	16.0	Rumex scutatus	15.8

Constant species (occurrence frequencies)

Rumex scutatus	19.0	Vincetoxicum hirundinaria	14.0
Picris hieracioides	14.0	Galeopsis angustifolia	14.0
Sedum sediforme	13.0	Melica ciliata aggr.	12.0

Dominant species (percentage frequencies of occurrences with cover > 25%)

U29 - Eastern Mediterranean base-rich scree

*Diagnostic species (phi coefficient * 100)*

Cicer incisum	45.2	Silene variegata	41.5
Scutellaria hirta	40.6	Satureja spinosa	29.4
Alyssum sphacioticum	29.3	Peucedanum alpinum	29.2
Ricotia cretica	27.2	Asperula serotina	27.0
Astragalus angustifolius	26.9	Mattiastrum lithospermifolium	26.7
Viola fragrans	25.3	Valantia aprica	24.6
Asperula idaea	23.8	Bufonia stricta	21.1

Vavilovia formosa	20.8	Heldreichia bupleurifolia	20.8
Geocaryum creticum	20.8	Dianthus sphacioticus	20.8
Cynoglossum sphacioticum	20.8	Cardamine carnosa	20.8
Senecio fruticulosus	20.7	Prunus discolor	20.7
Euphorbia pestalozzae	20.7	Cyanus reuterianus	20.7
Veronica thymifolia	20.6	Lamium eriocephalum	20.5
Aethionema saxatile	20.5	Arenaria saponarioides	20.4
Viola stojanowii	20.3	Lactuca alpestris	20.3
Alyssum handelii	20.3	Festuca pinifolia	20.2
Achillea ambrosiaca	20.2	Alyssum lassiticum	19.8
Aegokeras caespitosa	19.8	Silene odontopetala	19.7
Saxifraga scardica	19.3	Acantholimon ulicinum	19.1
Galium incanum	18.9	Tulipa saxatilis	18.2
Odontarrhena fragillima	18.1	Berberis cretica	18.0
Rhamnus saxatilis	17.7	Geranium glaberrimum	17.6
Euphorbia herniariifolia	17.5	Cyanus bourgaei	17.1
Asyneuma linifolium	16.9	Nepeta sphaciotica	16.8
Sedum litoreum	16.7	Scilla nana	16.5
Corydalis uniflora	16.5	Verbascum cheiranthifolium	16.3
Viola graeca	16.0	Elytrigia lazica	16.0
Dianthus elegans	15.3	Thymus teucrioides	15.0
Centaurea cariensis	15.0		

Constant species (occurrence frequencies)

Astragalus angustifolius	30.0	Scutellaria hirta	22.0
Rhamnus saxatilis	22.0	Cicer incisum	22.0
Aethionema saxatile	22.0	Silene variegata	17.0
Satureja spinosa	13.0	Berberis cretica	13.0
Asperula idaea	13.0	Acantholimon ulicinum	13.0

Dominant species (percentage frequencies of occurrences with cover > 25%)

U2A - Crimean base-rich scree

*Diagnostic species (phi coefficient * 100)*

Elytrigia bessarabica	96.3	Silene subconica	87.5
Sideritis montana	80.5	Odontarrhena tortuosa	77.6
Artemisia arenaria	74.3	Crambe maritima	71.8
Pimpinella tragium	69.0	Linaria genistifolia	67.3
Euphorbia seguieriana	49.8	Teucrium polium aggr.	39.3
Poa bulbosa	30.5		

Constant species (occurrence frequencies)

Teucrium polium aggr.	100.0	Silene subconica	100.0
Sideritis montana	100.0	Poa bulbosa	100.0
Pimpinella tragium	100.0	Odontarrhena tortuosa	100.0
Linaria genistifolia	100.0	Euphorbia seguieriana	100.0

Elytrigia repens aggr.	100.0	Elytrigia bessarabica	100.0
Crambe maritima	100.0	Artemisia arenaria	100.0

Dominant species (percentage frequencies of occurrences with cover > 25%)

U32 - Temperate high-mountain siliceous inland cliff

*Diagnostic species (phi coefficient * 100)*

Androsace vandellii	52.7	Asplenium septentrionale	33.7
Primula latifolia	30.6	Jovibarba heuffelii	29.4
Silene lerchenfeldiana	29.3	Saxifraga pentadactylis	29.0
Draba dubia	29.0	Saxifraga pubescens	28.4
Veronica bachofenii	27.8	Primula hirsuta	27.4
Cardamine resedifolia	25.1	Phyteuma hemisphaericum	24.7
Dianthus henteri	22.3	Thymus comosus	21.1
Eritrichium nanum	21.0	Saxifraga geranioides	20.4
Galium tendae	20.0	Saxifraga retusa	19.9
Alchemilla saxatilis	19.6	Phyteuma humile	16.5
Sempervivum arachnoideum	16.4	Potentilla nivalis	16.3
Saxifraga bryoides	15.4	Primula villosa	15.3

Constant species (occurrence frequencies)

Asplenium septentrionale	40.0	Androsace vandellii	33.0
Phyteuma hemisphaericum	25.0	Cardamine resedifolia	22.0
Poa nemoralis	19.0	Draba dubia	18.0
Jovibarba heuffelii	16.0	Sedum brevifolium	15.0
Primula latifolia	15.0	Polypodium vulgare	15.0
Sempervivum arachnoideum	14.0	Saxifraga pentadactylis	14.0
Saxifraga paniculata	12.0	Saxifraga bryoides	12.0
Primula hirsuta	12.0	Asplenium trichomanes	12.0
Juncus trifidus	11.0	Cystopteris fragilis	11.0
Alchemilla saxatilis	11.0		

Dominant species (percentage frequencies of occurrences with cover > 25%)

U33 - Temperate, lowland to montane siliceous inland cliff

*Diagnostic species (phi coefficient * 100)*

Asplenium septentrionale	32.5	Asplenium obovatum	17.5
Hieracium umbellatum	15.5		

Constant species (occurrence frequencies)

Asplenium septentrionale	38.0	Campanula rotundifolia	35.0
Asplenium trichomanes	30.0	Hieracium umbellatum	28.0
Polypodium vulgare	25.0	Asplenium adiantum-nigrum	19.0
Rumex acetosella	17.0	Festuca ovina	14.0

Hylotelephium maximum	12.0	Cystopteris fragilis	12.0
Umbilicus rupestris	11.0		

Dominant species (percentage frequencies of occurrences with cover > 25%)

U34 - Mediterranean siliceous inland cliff

*Diagnostic species (phi coefficient * 100)*

Armeria leucocephala	38.5	Potentilla crassinervia	37.1
Castroviejoa frigida	36.5	Phyteuma serratum	33.6
Festuca sardoa	27.8	Bupleurum stellatum	26.6
Silene requienii	25.8	Asarina procumbens	25.8
Saxifraga pedemontana	20.2	Laserpitium halleri	20.2
Hieracium amplexicaule	19.6	Sedum dasyphyllum	17.3
Leucanthemum monspeliense	16.2	Asplenium septentrionale	15.5

Constant species (occurrence frequencies)

Helichrysum italicum	22.0	Asplenium trichomanes	20.0
Sedum dasyphyllum	19.0	Asplenium septentrionale	19.0
Potentilla crassinervia	16.0	Dianthus sylvestris	16.0
Armeria leucocephala	16.0	Umbilicus rupestris	15.0
Castroviejoa frigida	15.0	Sedum brevifolium	14.0
Saxifraga pedemontana	14.0	Phyteuma serratum	14.0
Hieracium amplexicaule	14.0	Asplenium adiantum-nigrum	14.0
Hypochaeris robertia	11.0	Festuca sardoa	11.0
Asarina procumbens	11.0		

Dominant species (percentage frequencies of occurrences with cover > 25%)

U35 - Boreal and Arctic base-rich inland cliff

*Diagnostic species (phi coefficient * 100)*

Poa alpigena	46.6	Salix hastata	42.3
Phyllodoce caerulea	38.6	Cerastium fontanum subsp. fontanum	35.5
Dianthus versicolor	34.6	Viola biflora	31.1
Neottianthe cucullata	28.5	Draba podolica	26.8
Equisetum scirpoides	26.7	Geranium sylvaticum aggr.	26.5
Pedicularis lapponica	25.5	Thalictrum alpinum	24.5
Linnaea borealis	24.4	Thymus bashkiriensis	24.3
Trifolium lupinaster	24.2	Campanula rotundifolia	24.0
Salix myrtilloides	23.8	Salix glauca	23.5
Diapensia lapponica	23.2	Equisetum pratense	23.1
Psephellus sibiricus	22.6	Melampyrum sylvaticum	22.0
Androsace septentrionalis	21.3	Salix phylicifolia	20.3
Parietaria lusitanica	20.3	Arabidopsis petraea	20.3

Neottia cordata	20.2	Artemisia sericea	19.2
Pyrola minor	16.9	Antennaria alpina	16.3
Hieracium lachenalii	16.0	Betula pubescens var. pumila	15.8
Bistorta vivipara	15.5	Luzula pilosa	15.3
Trientalis europaea	15.2	Carex capillaris	15.2
Calamagrostis lapponica	15.1		

Constant species (occurrence frequencies)

Viola biflora	67.0	Campanula rotundifolia	67.0
Geranium sylvaticum aggr.	58.0	Festuca ovina	50.0
Vaccinium vitis-idaea	42.0	Phyllodoce caerulea	42.0
Linnaea borealis	42.0	Bistorta vivipara	42.0
Vaccinium myrtillus	33.0	Trientalis europaea	33.0
Thalictrum alpinum	33.0	Solidago virgaurea	33.0
Salix hastata	33.0	Poa alpigena	33.0
Melampyrum sylvaticum	33.0	Luzula pilosa	33.0
Avenella flexuosa	33.0	Salix glauca	25.0
Pedicularis lapponica	25.0	Hieracium lachenalii	25.0
Equisetum pratense	25.0	Empetrum nigrum aggr.	25.0
Anthoxanthum odoratum aggr.	25.0	Veronica alpina	17.0
Vaccinium uliginosum	17.0	Silene nutans	17.0
Selaginella selaginoides	17.0	Saussurea alpina aggr.	17.0
Salix phylicifolia	17.0	Rumex acetosa	17.0
Rubus chamaemorus	17.0	Ranunculus acris aggr.	17.0
Pyrola rotundifolia	17.0	Pyrola minor	17.0
Orthilia secunda	17.0	Neottia cordata	17.0
Gymnocarpium dryopteris	17.0	Festuca valesiaca aggr.	17.0
Eriophorum angustifolium	17.0	Equisetum variegatum	17.0
Equisetum scirpoides	17.0	Dianthus versicolor	17.0
Deschampsia cespitosa aggr.	17.0	Cerastium fontanum subsp. fontanum	17.0
Carex vaginata	17.0	Carex capillaris	17.0
Calamagrostis lapponica	17.0	Bartsia alpina	17.0
Antennaria alpina	17.0		

Dominant species (percentage frequencies of occurrences with cover > 25%)

U36 - Temperate high-mountain base-rich inland cliff

*Diagnostic species (phi coefficient * 100)*

Draba tomentosa	30.4	Saxifraga squarrosa	29.3
Potentilla clusiana	28.4	Campanula zoysii	26.6
Androsace helvetica	26.6	Sesleria sphaerocephala	26.3
Carex firma	23.6	Campanula cochleariifolia	23.6
Saxifraga media	21.4	Potentilla nitida	21.4
Globularia repens	20.8	Rhamnus pumila	20.3
Artemisia umbelliformis	18.7	Primula auricula	18.6

Carex mucronata	17.8	Trisetum alpestre	17.5
Draba stellata	17.3	Phyteuma charmelii	16.8
Valeriana apula	16.7	Saxifraga paniculata	16.6
Petrocallis pyrenaica	16.6	Saxifraga caesia	16.4
Potentilla nivalis	16.2	Primula marginata	15.6

Constant species (occurrence frequencies)

Campanula cochleariifolia	28.0	Saxifraga paniculata	21.0
Carex firma	20.0	Globularia repens	17.0
Cystopteris fragilis	17.0	Sesleria caerulea	16.0
Asplenium ruta-muraria	16.0	Silene acaulis	14.0
Saxifraga oppositifolia	14.0	Primula auricula	14.0
Potentilla clusiana	14.0	Viola biflora	13.0
Saxifraga moschata	12.0	Rhamnus pumila	12.0
Festuca quadriflora	12.0	Saxifraga squarrosa	11.0

Dominant species (percentage frequencies of occurrences with cover > 25%)

U37 - Temperate, lowland to montane base-rich inland cliff

*Diagnostic species (phi coefficient * 100)*

Asplenium ruta-muraria	19.3

Constant species (occurrence frequencies)

Asplenium ruta-muraria	28.0	Sanguisorba minor aggr.	23.0
Asplenium trichomanes	20.0	Campanula rotundifolia	18.0
Euphorbia cyparissias	17.0	Asperula cynanchica	17.0
Sesleria caerulea	15.0	Sedum album	11.0

Dominant species (percentage frequencies of occurrences with cover > 25%)

U38 - Mediterranean base-rich inland cliff

*Diagnostic species (phi coefficient * 100)*

Asplenium ceterach	21.5	Sarcocapnos enneaphylla	19.2
Asplenium petrarchae	18.0	Asplenium fontanum	16.9
Sedum creticum	16.7	Phagnalon sordidum	16.5
Hormathophylla ligustica	15.8		

Constant species (occurrence frequencies)

Asplenium trichomanes	28.0	Asplenium ceterach	28.0
Asplenium ruta-muraria	21.0	Sedum dasyphyllum	15.0
Campanula rotundifolia	15.0	Thymus vulgaris	14.0
Sanguisorba minor aggr.	13.0		

Dominant species (percentage frequencies of occurrences with cover > 25%)

U3A - Temperate ultramafic inland cliff

*Diagnostic species (phi coefficient * 100)*

Asplenium adiantum-nigrum subsp. serpentini	51.0	Asplenium adulterinum	47.3
Paragymnopteris marantae	34.4	Daphne malyana	21.3
Polygonum setosum	21.2	Barbarea brachycarpa	21.2
Micromeria croatica	20.9	Ranunculus buhsei	20.7
Bryum capillare group	19.0	Hedysarum macedonicum	18.8
Bornmuellera dieckii	17.1	Hieracium waldsteinii	16.8
Festuca pallens	16.7	Stipa novakii	16.6
Erysimum linariifolium	15.7	Moltkia petraea	15.6
Anomodon attenuatus	15.6	Lomelosia rotata	15.0

Constant species (occurrence frequencies)

Asplenium adiantum-nigrum subsp. serpentini	50.0	Paragymnopteris marantae	32.0
Thymus praecox	23.0	Asplenium adulterinum	23.0
Silene vulgaris	18.0	Festuca pallens	18.0
Campanula rotundifolia	18.0	Thymus pulegioides	14.0
Taraxacum sect. Taraxacum	14.0	Poa pratensis aggr.	14.0
Poa badensis aggr.	14.0	Plantago holosteum	14.0
Minuartia verna aggr.	14.0	Hypnum cupressiforme aggr.	14.0
Festuca ovina	14.0	Asplenium trichomanes	14.0
Asplenium ruta-muraria	14.0	Achillea millefolium aggr.	14.0

Dominant species (percentage frequencies of occurrences with cover > 25%)

Paragymnopteris marantae	9.0	Asplenium adiantum-nigrum subsp. serpentini	9.0

U3B - Mediterranean ultramafic inland cliff

*Diagnostic species (phi coefficient * 100)*

Festucopsis serpentini	74.1	Viola magellensis	54.7
Odontarrhena bertolonii	41.3	Sesleria coerulans	40.7
Asplenium adiantum-nigrum subsp. serpentini	33.8	Cardamine pancicii	33.3
Silene schwarzenbergeri	33.0	Erysimum kuemmerlei	32.4
Hypericum spruneri	30.1	Centaurea micrantha	29.8
Reseda virgata	28.4	Leontodon asperrimus	28.4
Trigonella balansae	26.8	Armeria langei	26.8
Linum elegans	25.6	Genista hassertiana	25.6
Potentilla apennina	25.1	Silene parnassica	24.9
Amphoricarpos neumayerianus	22.5	Crepis conyzifolia	22.2
Silene armeria	20.9	Cardamine glauca	20.9

Silene multicaulis	20.3	Sedum album	20.1
Linum campanulatum	19.7	Asplenium ceterach	16.7
Koeleria crassipes	15.0		

Constant species (occurrence frequencies)

Festucopsis serpentini	56.0	Sedum album	44.0
Viola magellensis	33.0	Sesleria coerulans	33.0
Asplenium adiantum-nigrum subsp. serpentini	33.0	Odontarrhena bertolonii	22.0
Minuartia verna aggr.	22.0	Dianthus sylvestris	22.0
Asplenium ceterach	22.0	Tuberaria guttata	11.0
Trigonella balansae	11.0	Trifolium arvense	11.0
Tortella tortuosa	11.0	Silene schwarzenbergeri	11.0
Silene parnassica	11.0	Silene multicaulis	11.0
Silene armeria	11.0	Sedum rupestre	11.0
Rumex scutatus	11.0	Reseda virgata	11.0
Reichardia picroides	11.0	Ranunculus acris aggr.	11.0
Potentilla apennina	11.0	Plantago subulata	11.0
Paragymnopteris marantae	11.0	Odontarrhena muralis	11.0
Linum elegans	11.0	Linum campanulatum	11.0
Leontodon crispus aggr.	11.0	Leontodon asperrimus	11.0
Koeleria splendens	11.0	Koeleria macrantha	11.0
Koeleria crassipes	11.0	Hypericum spruneri	11.0
Helichrysum italicum	11.0	Genista hassertiana	11.0
Galium lucidum	11.0	Erysimum kuemmerlei	11.0
Edraianthus graminifolius	11.0	Crepis conyzifolia	11.0
Centaurea micrantha	11.0	Cardamine pancicii	11.0
Cardamine glauca	11.0	Asperula cynanchica	11.0
Armeria langei	11.0	Arenaria querioides	11.0
Amphoricarpos neumayerianus	11.0		

Dominant species (percentage frequencies of occurrences with cover > 25%)

U3C - Macaronesian inland cliff

*Diagnostic species (phi coefficient * 100)*

Rhamnus integrifolia	28.2	Aeonium palmense	26.5
Sonchus acaulis	25.2	Sonchus hierrensis	25.0
Aeonium diplocyclum	22.3	Teline osyroides	20.0
Silene berthelotiana	20.0	Sideritis nutans	20.0
Sideritis amagroi	20.0	Sedum brissemoretii	20.0
Phyllis viscosa	20.0	Monanthes lowei	20.0
Limonium relicticum	20.0	Ferula latipinna	20.0
Crambe tamadabensis	20.0	Crambe arborea	20.0
Convolvulus lopezsocasi	20.0	Convolvulus fruticulosus	20.0
Cheirolophus satarataensis	20.0	Bencomia caudata	20.0
Asplenium monanthes	20.0	Aeonium smithii	20.0

Aeonium balsamiferum	20.0	Sedum nudum	19.9
Bethencourtia palmensis	19.9	Lotus emeroides	19.8
Nicotiana paniculata	19.7	Cyrtomium falcatum	19.0
Athamanta cervariifolia	19.0	Monanthes brachycaulos	18.7
Sonchus ustulatus	18.6	Malva acerifolia	17.6
Cheirolophus canariensis	17.6	Matthiola maderensis	16.5
Crambe fruticosa	16.5	Brachypodium arbuscula	16.4
Maytenus senegalensis	15.9	Aeonium aureum	15.4
Sideritis lotsyi	15.1		

Constant species (occurrence frequencies)

Davallia canariensis	16.0	Sonchus hierrensis	12.0
Sonchus acaulis	12.0	Polypodium cambricum subsp. macaronesicum	12.0
Kleinia neriifolia	12.0	Aeonium palmense	12.0
Aeonium glandulosum	12.0		

Dominant species (percentage frequencies of occurrences with cover > 25%)

U3D - Wet inland cliff

*Diagnostic species (phi coefficient * 100)*

Adiantum capillus-veneris	55.0	Pinguicula grandiflora	44.9
Cymbalaria muralis	22.9	Samolus valerandi	22.8
Pinguicula poldinii	19.5	Hypericum hircinum	18.2
Eucladium verticillatum	18.1	Hymenostylium recurvirostrum	16.9
Trachelium caeruleum	16.6	Doronicum corsicum	15.8

Constant species (occurrence frequencies)

Adiantum capillus-veneris	53.0	Pinguicula grandiflora	31.0
Samolus valerandi	27.0	Molinia caerulea aggr.	14.0
Parietaria judaica	12.0	Hypericum hircinum	12.0
Cymbalaria muralis	12.0		

Dominant species (percentage frequencies of occurrences with cover > 25%)

U52 - Polar desert

*Diagnostic species (phi coefficient * 100)*

Luzula confusa	89.4	Cassiope tetragona	44.2
Hierochloe alpina	43.7	Juncus trifidus	35.0
Carex bigelowii	33.4	Cardamine bellidifolia	31.0
Agrostis mertensii	24.8	Festuca ovina	23.0
Cassiope hypnoides	22.4	Antennaria alpina	19.6
Sibbaldia procumbens	16.0	Veronica alpina	15.9
Vaccinium vitis-idaea	15.1		

Constant species (occurrence frequencies)

Luzula confusa	100.0	Festuca ovina	80.0
Vaccinium vitis-idaea	60.0	Juncus trifidus	60.0
Carex bigelowii	60.0	Cassiope tetragona	40.0
Veronica alpina	20.0	Sibbaldia procumbens	20.0
Lycopodium annotinum	20.0	Hierochloe alpina	20.0
Hieracium lachenalii	20.0	Gnaphalium supinum	20.0
Cassiope hypnoides	20.0	Cardamine bellidifolia	20.0
Bistorta vivipara	20.0	Betula nana	20.0
Antennaria alpina	20.0	Agrostis mertensii	20.0

Dominant species (percentage frequencies of occurrences with cover > 25%)

U61 - Subarctic volcanic field

*Diagnostic species (phi coefficient * 100)*

Salix herbacea	43.4	Galium normanii	36.1
Sagina nivalis	34.8	Saxifraga cespitosa	30.4
Saxifraga oppositifolia	17.6	Salix lanata	16.9
Oxyria digyna	16.2	Koenigia islandica	15.2

Constant species (occurrence frequencies)

Salix herbacea	80.0	Saxifraga oppositifolia	25.0
Poa alpina	20.0	Oxyria digyna	20.0
Carex bigelowii	20.0	Thymus serpyllum	15.0
Silene uniflora	15.0	Saxifraga cespitosa	15.0
Sagina nivalis	15.0	Galium normanii	15.0
Festuca vivipara	15.0	Empetrum nigrum aggr.	15.0
Bistorta vivipara	15.0	Betula pubescens	15.0
Arctostaphylos uva-ursi	15.0	Alchemilla alpina	15.0

Dominant species (percentage frequencies of occurrences with cover > 25%)

U62 - Mediterranean, Macaronesian and temperate volcanic field

*Diagnostic species (phi coefficient * 100)*

Rumex aetnensis	74.7	Anthemis aetnensis	73.3
Scleranthus perennis subsp. vulcanicus	67.0	Senecio squalidus subsp. aethnensis	62.1
Viola cheiranthifolia	50.8	Silene nocteolens	44.7
Descurainia bourgaeana	37.9	Hypochaeris robertia	35.6
Viola aetnensis	34.2	Echium auberianum	33.6
Rhaponticum centauroides	29.6	Erysimum scoparium	28.2
Argyranthemum tenerifae	27.2	Erigeron calderae	22.3
Saponaria sicula	20.0	Cerastium tomentosum	19.8

Constant species (occurrence frequencies)

Rumex aetnensis	60.0	Anthemis aetnensis	55.0
Hypochaeris robertia	50.0	Senecio squalidus subsp. aethnensis	45.0
Scleranthus perennis subsp. vulcanicus	45.0	Viola cheiranthifolia	30.0
Erysimum scoparium	30.0	Descurainia bourgaeana	30.0
Viola aetnensis	20.0	Silene nocteolens	20.0
Argyranthemum tenerifae	20.0	Echium auberianum	15.0
Cerastium tomentosum	15.0		

Dominant species (percentage frequencies of occurrences with cover > 25%)

Appendix F: List of databases and data providers

GIVD code	GIVD database name	Custodian	Deputy custodian	# of plots
00-RU-006	Database of non-forest vegetation of the Southern Urals	Sergey Yamalov	Mariya Lebedeva	75
00-TR-001	Forest Vegetation Database of Turkey - FVDT	Ali Kavgacı		102
AS-RU-005	Nenets Tundra	Igor Lavrinenko		123
AS-TR-001	Vegetation Database of the Grassland Communities in Anatolia	Behlül Güler	Deniz Işık Gürsoy	20
EU-00-002	Nordic-Baltic Grassland Vegetation Database (NBGVD)	Jürgen Dengler	Łukasz Kozub	18
EU-00-004	Iberian and Macaronesian Vegetation Information System (SIVIM)	Xavier Font		186
EU-00-004	Iberian and Macaronesian Vegetation Information System (SIVIM)	Borja Jiménez-Alfaro	Xavier Font	99
EU-00-004	Iberian and Macaronesian Vegetation Information System (SIVIM)	Maria Pilar Rodríguez-Rojo	Xavier Font	76
EU-00-004	Iberian and Macaronesian Vegetation Information System (SIVIM)	Borja Jiménez-Alfaro	Xavier Font	80
EU-00-004	Iberian and Macaronesian Vegetation Information System (SIVIM)	Federico Fernández-González	Xavier Font	22
EU-00-004	Iberian and Macaronesian Vegetation Information System (SIVIM)	Rosario G Gavilán	Xavier Font	23
EU-00-011	Vegetation-Plot Database of the University of the Basque Country (BIOVEG)	Idoia Biurrun	Itziar García-Mijangos	554
EU-00-013	Balkan Dry Grasslands Database	Kiril Vassilev	Armin Macanović	49
EU-00-016	Mediterranean Ammophiletea database	Corrado Marcenò	Borja Jiménez-Alfaro	76
EU-00-017	European Coastal Vegetation Database	John Janssen		796
EU-00-018	The Nordic Vegetation Database	Jonathan Lenoir	Jens-Christian Svenning	86
EU-00-018	The Nordic Vegetation Database	Jonathan Lenoir	Jens-Christian Svenning	13

EU-00-019	Balkan Vegetation Database	Kiril Vassilev	Hristo Pedashenko	73
EU-00-022	European Mire Vegetation Database	Tomáš Peterka	Martin Jiroušek	2
EU-00-023	Iberian and Macaronesian Vegetation Information System (SIVIM) – Deciduous Forests	Juan Antonio Campos	Xavier Font	18
EU-00-024	Iberian and Macaronesian Vegetation Information System (SIVIM) – Floodplain Forests	Idoia Biurrun	Xavier Font	1
EU-00-025	Gravel bar vegetation database	Veronika Kalníková	Helmut Kudrnovsky	5
EU-00-026	CircumMed Pine Forest database	Gianmaria Bonari		1
EU-00-027	European Boreal Forest Vegetation Database	Anni Kanerva Jašková		6
EU-00-028	European Weed Vegetation Database	Filip Küzmič	Urban Šilc	56
EU-00-029	High Mediterranean Mountains Database	Gianpietro Giusso del Galdo	Corrado Marcenò	45
EU-00–030	EU-00–030	Denys Vynokurov		70
EU-00-031	Masaryk University's Gap-Filling Database of European Vegetation	Milan Chytrý	Ilona Knollová	2
EU-AL-001	Vegetation Database of Albania	Michele De Sanctis	Giuliano Fanelli	30
EU-AT-001	Austrian Vegetation Database	Wolfgang Willner		513
EU-BE-002	INBOVEG	Els De Bie		1
EU-BE-002	INBOVEG	Els De Bie		14
EU-BG-001	Bulgarian Vegetation Database	Iva Apostolova	Desislava Sopotlieva	9
EU-CH-005	Swiss Forest Vegetation Database	Thomas Wohlgemuth		34
EU-CH-011	Monitoring Effectiveness of Habitat Conservation in Switzerland	Ariel Bergamini	Steffen Boch	74
EU-CZ-001	Czech National Phytosociological Database	Milan Chytrý	Ilona Knollová	283
EU-DE-001	VegMV	Florian Jansen	Christian Berg	428
EU-DE-013	VegetWeb Germany	Florian Jansen	Jörg Ewald	19
EU-DE-013	VegetWeb Germany	Friedemann Goral	Florian Jansen	521
EU-DE-013	VegetWeb Germany	Friedemann Goral	Florian Jansen	191
EU-DE-014	German Vegetation Reference Database (GVRD)	Ute Jandt	Helge Bruelheide	68

EU-DE-020	German Grassland Vegetation Database (GrassVeg.DE)	Jürgen Dengler	Ricarda Pätsch	2296
EU-DE-035	Coastal Vegetation Germany	Maike Isermann	Florian Jansen	16
EU-ES-001	Iberian and Macaronesian Vegetation Information System (SIVIM) – Wetlands	Aaron Pérez-Haase	Xavier Font	89
EU-FR-003	SOPHY	Henry Brisse	Patrice de Ruffray	6757
EU-GB-001	UK National Vegetation Classification Database	John S. Rodwell		2532
EU-GR-001	KRITI	Erwin Bergmeier		119
EU-GR-005	Hellenic Natura 2000 Vegetation Database (HelNatVeg)	Panayotis Dimopoulos	Ioannis Tsiripidis	15
EU-HR-001	Phytosociological Database of Non-Forest Vegetation in Croatia	Zvjezdana Stančić		9
EU-HR-002	Croatian Vegetation Database	Željko Škvorc	Daniel Krstonošić	281
EU-HU-003	CoenoDat Hungarian Phytosociological Database	János Csiky	Zoltán Botta-Dukát	74
EU-IE-001	Irish Vegetation Database	Úna FitzPatrick	Lynda Weekes	996
EU-IT-001	VegItaly	Roberto Venanzoni	Flavia Landucci	3
EU-IT-010	Vegetation database of Habitats in the Italian Alps - HabItAlp	Laura Casella	Pierangela Angelini	30
EU-IT-011	Vegetation Plot Database - Sapienza University of Rome	Emiliano Agrillo	Fabio Attorre	707
EU-IT-019	VIOLA	Angela Stanisci	Maria Laura Carranza	58
EU-IT-020	RanVegDunes	Alicia Acosta		4
EU-LT-001	Lithuanian vegetation Database	Valerius Rašomavičius	Domas Uogintas	1
EU-LV-001	Semi-natural Grassland Vegetation Database of Latvia	Solvita Rūsiņa		7
EU-MK-001	Vegetation Database of the Republic of Macedonia	Renata Ćušterevska		13
EU-NL-001	Dutch National Vegetation Database	Stephan Hennekens	Joop Schaminée	5329
EU-NL-003	Dutch Military Ranges Vegetation Database (DUMIRA)	Iris de Ronde	Rense Haveman	259
EU-PL-001	Polish Vegetation Database	Zygmunt Kącki	Grzegorz Swacha	138
EU-PT-001	Serra da Estrela database	Jan Jansen		15

EU-RO-007	Romanian Forest Database	Adrian Indreica	Pavel Dan Turtureanu	1
EU-RO-008	Romanian Grassland Database	Eszter Ruprecht	Kiril Vassilev	326
EU-RS-002	Vegetation Database Grassland Vegetation of Serbia	Svetlana Aćić	Zora Dajić Stevanović	9
EU-RU-002	Lower Volga Valley Phytosociological Database	Valentin Golub	Andrei Chuvashov	653
EU-RU-003	Vegetation Database of the Volga and the Ural Rivers Basins	Tatiana Lysenko		31
EU-RU-011	Vegetation Database of Tatarstan	Vadim Prokhorov		8
EU-RU-014	Temperate Forests of European Russia	Larisa Khanina	Maxim Bobrovsky	1
EU-SI-001	Vegetation Database of Slovenia	Urban Šilc	Filip Küzmič	355
EU-SK-001	Slovak Vegetation Database	Milan Valachovič	Jozef Šibík	118
EU-UA-001	Ukrainian Grassland Database	Anna Kuzemko	Yulia Vashenyak	280
EU-UA-005	Halophytic and coastal vegetation database of Ukraine	Tetiana Dziuba	Dmytro Dubyna	30
EU-UA-006	Vegetation Database of Ukraine and Adjacent Parts of Russia	Viktor Onyshchenko	Vitaliy Kolomiychuk	214
	CBNA	Sylvain Abdulhak	Jean-Michel Genis	26
	European Alpine Vegetation Database	Borja Jiménez-Alfaro	Jozef Šibík	3
	French National Forest Inventory	https://inventaire-forestier.ign.fr/spip.php?rubrique149		1
	Grasslands GVRD	Ute Jandt		303
	Private data of Andrey Korolyuk	Andrey Korolyuk		58
	Private data of Borja Jiménez-Alfaro	Borja Jiménez-Alfaro		8
	Private data of Corrado Marcenò	Corrado Marcenò		7
	Private data of Ioannis Tsiripidis	Ioannis Tsiripidis		1
	Steppe vegetation Rostov Region Database	Olga Demina		60
	Swedish National Forest Inventory	https://www.slu.se/nfi		3
	Teberda - Caucasus Database	Vladimir Onipchenko	Alexei Egorov	60
			Total	**27166**