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3 **The Romanian Grassland Database (RGD): historical background, current status and future perspectives**

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14 **Running title:** Romanian Grassland Database (RGD)

15

16 **Abstract:** This report describes the Romanian Grassland Database (RGD), registered under EU-RO-008 in the Global
17 Index of Vegetation-Plot Databases (GIVD). This collaborative initiative aims to collect all available vegetation-plot
18 data (relevés) of grasslands and other open habitats from the territory of Romania to provide them for science,
19 nationally and internationally, e.g. via the European Vegetation Archive (EVA) and the global database “sPlot”. The
20 database mainly contains vegetation-plots from not only wet, mesic, dry, saline, alpine and rocky grasslands, but also
21 other vegetation types like heathlands, mires, ruderal, segetal, aquatic and cryptogam-dominated vegetation. Currently,
22 21,685 relevés have mainly been digitised from literature sources (90%), while the remainder comes from individual
23 unpublished sources (10%). We report on the background and history of the RGD, explain its “Data Property and
24 Governance Rules” under which data are contributed and retrieved, and outline how the RGD can contribute to research
25 in the fields of vegetation ecology, macroecology and conservation.

26 **Keywords:** ecoinformatics; European Vegetation Archive (EVA); grassland vegetation; phytosociology; relevé;
27 Romanian Grassland Database (RGD); sPlot; Turboveg; vegetation classification; vegetation-plot data.

28 **Abbreviations:** EVA = European Vegetation Archive; GIVD = Global Index of Vegetation-Plot Databases; RGD =
29 Romanian Grassland Database.

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33 **GIVD Fact Sheet**

#Separate file#

34 **Introduction**

35 Vegetation-plot databases provide a powerful source of information for plant community ecology, macroecology and
36 conservation biology as they combine fine-grain co-occurrence data of plant species across large spatial extents
37 (Dengler et al. 2011; Chytrý et al. 2016). Europe, due to its strong phytosociological tradition (Braun-Blanquet 1965;
38 Dengler et al. 2008) probably is the continent with the largest number of vegetation-plot records (relevés), totalling
39 several millions (Schaminée et al. 2009; Dengler et al. 2011). Over the last 25 years, in many European countries
40 comprehensive national vegetation-plot databases have emerged (Schaminée et al. 2009), which subsequently gave rise
41 to the integrated European Vegetation Archive (EVA; <http://euroveg.org/eva-database>; Chytrý et al. 2016) and the
42 global database “sPlot” (<https://www.idiv.de/splot>; Dengler & sPlot Core Team 2014). Schaminée et al. (2009)
43 estimated that in Romania more than 70,000 relevés exist, although at the time of publication none of these data were
44 digitally available in a database.

45 Meanwhile, the development of the Global Index of Vegetation-Plot Databases (GIVD; <http://www.givd.info/>; Dengler
46 et al. 2011) inspired several colleagues to establish and register in GIVD smaller databases with plots from Romania,
47 including the “Vegetation Database of Dry Grasslands in the Southeast Romania” (Biță-Nicolae 2012; EU-RO-001), the
48 “Vegetation Database of the Dry Grasslands from the Transylvanian Basin” (Ruprecht et al. 2012; EU-RO-002) and

49 “Mesophilic Pastures in Southern Transylvania, Romania” (by L. Sutcliffe; EUR-RO-006). When the EVA was
50 established, its team sought to facilitate the establishment of one or few larger national vegetation databases in Romania
51 that could serve as competent partners for the European initiative. As a result, the three named grassland databases
52 joined to form the Romanian Grassland Database (RGD; EU-RO-008) which aimed to comprise all vegetation types of
53 grasslands and other open habitats from the country. Similarly, several smaller forest databases merged to form the
54 Romanian Forest Database (RGF; EU-RO-007) focusing on forests and shrublands (Indreica et al. in press).

55 In this article we introduce the RGD, its technical and organisational set-up, report on its current content, and provide a
56 view on future activities and opportunities.

57 **Knowledge of grasslands and other open habitats in Romania**

58 Based on the vast data that have accumulated over time, as a result of field investigations conducted by numerous
59 phytosociologists, a series of syntheses on the vegetation of Romania were published over the past seven decades, at
60 regional (e.g. Soó 1949; Borza 1963; Beldie & Dihoru 1967; Coldea 1991; Chifu et al. 2006) and national levels (e.g.
61 Borza et al. 1960; Puşcaru-Soroceanu et al. 1963; Doniță et al. 1992; Sanda et al. 1998; Coldea 1997, 2012; Chifu
62 2014). According to Coldea (1997, 2012), the herbaceous vegetation of Romania consists of 461 vascular plant
63 associations, grouped into 115 alliances, 56 orders and 35 classes. Of the total number of associations, ca. 42% (from 48
64 alliances, 24 orders and 18 classes) are comprised of natural vegetation and 58% (from 67 alliances, 32 orders and 17
65 classes) of anthropogenic vegetation (including secondary meadows and ruderal vegetation).

66 This diversity of syntaxa reflects the great variety of vegetation cover in Romania, resulting from the geomorphological
67 and climatic diversity of the country and its location at the intersection of several floristic provinces (Coldea 1997).
68 However, all the current classification schemes in Romania are based on “expert knowledge” only. To date, no
69 classification takes advantage of the large amount of existing vegetation-plot data that would allow the sound
70 delimitation of syntaxa and determination of their diagnostic species with transparent and reproducible (statistical)
71 methods (see De Cáceres et al. 2015).

72 **Emergence and organisation of the Romanian Grassland Database**

73 Unrecognized by the vegetation-plot community outside the country (e.g. Schaminée et al. 2009), 1,467 relevés from
74 dry grassland vegetation types were digitally collected by E. Ruprecht and colleagues in 2002. This later became the
75 “Vegetation Database of the Dry Grasslands from the Transylvanian Basin” (EU-RO-002; Ruprecht et al. 2012). The
76 Romanian Grassland Database (RGD) was created in 2014, via merging the existing Transylvanian database with
77 several smaller datasets of C. Biță-Nicolae, M. Janišová and J. Dengler, resulting in a total of 1,831 relevés. With the
78 establishment of the RGD Data Property and Governance Rules (Supplement S1), we expanded the database to not only
79 include grasslands s.str, but also all vegetation types of open habitats,. This together with an advertising campaign led to
80 dynamic growth of the database content from 7,528 relevés in May 2015 to 21,685 relevés in August 2017.

81 The RGD is registered in the Global Index of Vegetation-Plot Databases (GIVD; <http://www.givd.info>; Dengler et al.
82 2011) under EU-RO-008 (<http://www.givd.info/ID/EU-RO-008>). This database has contributed its vegetation-plot data
83 to the European Vegetation Archive (EVA; Chytrý et al. 2016), and to the global vegetation-plot database “sPlot”

84 (<http://www.idiv.de/splot>; Dengler & sPlot Core Team 2014). Since the spring of 2017, the RGD has maintained a
85 webpage on the Ecoinformatics Portal of the University of Bayreuth (<http://bit.ly/2vz011u>).

86 The RGD's Data Property and Governance Rules (Supplement S1) doubtlessly contributed much to its attractiveness
87 and success. The document regulates the governance of the database, data provision, type of data availability regimes,
88 data requests and terms of data use, rules for authorship and relationships with other databases like EVA, sPlot and
89 GIVD. These rules are phrased similarly to the EVA Data Property and Governance Rules
90 (<http://euroveg.org/download/eva-rules.pdf>) and the governance and Data Rules of the sPlot Working Group
91 ([http://www.idiv-biodiversity.de/sdiv/workshops/workshops-2013/splot/join/content_815683/sPlot-
92 Rules_approved.pdf](http://www.idiv-biodiversity.de/sdiv/workshops/workshops-2013/splot/join/content_815683/sPlot-
92 Rules_approved.pdf)). In essence, they show that the RGD is a collaborative, self-governed consortium that elects a
93 Custodian (currently E.R.) and a Deputy-Custodian (currently K.V.) to represent its interests and to coordinate daily
94 business. Currently, the RGD Consortium consists of 50 members of which one half is from Romania and the remainder
95 are people from abroad who study or studied Romanian vegetation.

96 The basic principle of the RGD that makes becoming a member so attractive is the concept of give-and-take. Only those
97 who contribute data to the RGD, and thus become members of the RGD Consortium, have access to full RGD content
98 and can propose projects making use of it. Likewise, RGD Consortium members are informed whenever there are
99 requests to utilize RGD data, either directly or via EVA or sPlot. When requests are made, one of the RGD Consortium
100 members can opt in as active co-author, while they themselves also can propose EVA and sPlot projects using the
101 whole European or global dataset. Over the last two years, data from the RGD were requested and provided for 30
102 projects via the EVA and sPlot databases, and some first papers resulting from these cooperations have been published
103 (e.g. Willner et al. 2017).

104 **Technical implementation**

105 The relevés of the RGD are managed and stored with the Turboveg v2.101 software (Hennekens & Schaminée 2001).
106 This facilitates effective data import and handling as well as very easy data provision to EVA and sPlot, which are run
107 under Turboveg v3 that allows the combination of many different Turboveg v2 databases. The database structure is
108 based on the standard header data fields of Turboveg v2, but many new fields have been added, both to allow retaining
109 as much as possible of the original information and to support the coordination and the rights management within and
110 between RGD, EVA and sPlot.

111 The species list of vascular plants was originally based on *Flora Europaea* (Tutin et al. 1964–1980), and augmented
112 with new taxa when needed. We also entered varieties and forms of species in order to keep the original information
113 from digitized publications. All changes in species nomenclature related to the original literature sources follow the
114 *Flora Europaea* database (<http://rbg-web2.rbge.org.uk/FE/fe.html>) and the Euro+Med PlantBase
115 (<http://www.emplantbase.org/home.html>) and are documented in a separate file. Names of bryophytes, lichens and
116 algae are currently stored in their original form and not yet standardized according to uniform checklists.

117 Author and “biblioreference” popup lists were created during digitization. The list of digitized publications and other
118 sources is provided in Supplement S2. Names of syntaxa were harmonized according to Sanda et al. (2008).

119 **Current content of RGD**

120 According to its Rules, the RGD collects data from all grassland vegetation types (wet, mesic, dry, saline, alpine,
121 rocky), and also other vegetation types, such as heathlands, ruderal and segetal vegetation, mires and aquatic vegetation
122 as well as cryptogam-dominated types from the territory of Romania (Fig. 1). Forests and the majority of shrublands are
123 not considered because they are captured by a parallel effort of the Romanian Forest Database (RFD; EU-RO-007;
124 Indreica et al. in press). However, there is currently some overlap between both national databases, concerning
125 communities dominated by shrubs and dwarf shrubs, mainly from the subalpine zone. Such stands, dominated by *Pinus*
126 *mugo*, *Juniperus sibirica*, *Alnus viridis*, *Vaccinium*, *Salix* and *Rubus* species constitute about 5% of the content of RGD
127 and might partly also be contained in RFD. In addition, some data of wetland vegetation (about 1%) are also included in
128 the WetVegEurope database (EU-00-020; Landucci et al. 2015) and some plots with “standard plot sizes” are shared
129 with the Database of Scale-Dependent Phytodiversity Patterns in Palaeartic Grasslands (GrassPlot; EU-00-003;
130 Dengler et al. 2012). We are cooperating with these other databases to avoid duplication of work in the future and to
131 ensure that each vegetation plot is delivered only once to EVA and sPlot.

132 The majority of the data in RGD was digitized from published literature sources (90%), while the rest are unpublished
133 relevés from Consortium members (10%). In total, the RGD currently contains data from nearly 500 different sources.
134 There are two periods during which the majority of vegetation plots were recorded (Fig. 1). The first peak (1960–1980)
135 refers to a large number of vegetation studies in different regions of the country, while the second peak (2001–2010) is
136 related to a great number of relevés sampled as a part of PhD or Master theses. The majority of plots are in the semi-
137 restricted data availability regime (87%; for specific definitions for access see the EVA; Chytrý et al. 2016), while few
138 have restricted access (10%) and even fewer have free access (3%).

139 Geographic coordinates are now available for 99.88% of the relevés (Fig. 2). While most sources (72%) did not contain
140 geographic coordinates, they were geo-referenced *a posteriori* using Google Earth and other available information
141 about the plot localities, which lead to coarse geographic precision (see Fact Sheet). Most of the relevés come from
142 mountainous and semi-mountainous parts of Romania, which are better explored compared to lowland areas (Fig. 2).
143 Traditionally, researchers focused mainly on the most distant, natural areas, whereas agricultural and rural areas were
144 less studied.

145 To complement the information provided in the Fact Sheet, we summarize the contents of the best-filled header data as
146 follows:

- 147 • Plot size ranges from 0.01 to 3,500 m². The most frequently used plot sizes are 100 m² (21.8%), 25 m² (21.0%)
148 and 10 m² (4.3%), while 19.9% of the plots lack such information.
- 149 • Data on non-vascular plants are available for 28% of the relevés.
- 150 • Elevation ranges from 0 to 2,525 m a.s.l., although 35% of the relevés are lacking this information.
- 151 • Aspect and slope are the two most often recorded environmental parameters and are available for 55% and
152 54% of the relevés, respectively, while land use and soil parameters are unfortunately rather sparse (< 10%) in
153 the current database (see Fact Sheet).
- 154 • Cover of vegetation: Total vegetation cover is provided for 31% of the relevés, while availability of individual
155 vegetation strata cover varies from 35% for the tree layer to 8% for the cryptogam layer.

156 • Syntaxa: 77.6% of the relevés in the RGD are classified into syntaxa of different levels (Table 1; Supplement
157 S1). Non-classified relevés (22.4%) mainly come from unpublished data sources or are cryptogam
158 communities, which are not included in syntaxon popup list.

159 **Summary and outlook**

160 With this Long Database Report we give credit to all of the vegetation scientists who actively contributed to mobilizing
161 Romanian vegetation-plot data, either by providing their own plots or helping with the digitization of data from the
162 literature for the RGD. From now on, we ask that this report be cited when data from the RGD are used.

163 The RGD has undergone dynamic development during recent years and now nicely complements the Romanian Forest
164 Database (RFD; Indreica et al. in press). We believe the success of the RGD is largely due to our transparent rules that
165 balance the interests of data providers, data managers and data users in a fair manner. The RGD and RFD together
166 currently contain more than 31,000 relevés, which is nearly half the amount of existing relevés from the country as
167 estimated by Schaminée et al. (2009). However, our estimate exceeds Schaminée et al.'s in that there are at least
168 100,000 relevés alone of open habitats, so in short about 75% still remain to be mobilized. Thus, we hope that this
169 publication together with Indreica et al. (in press) will further stimulate researchers to contribute their data and join one
170 or the other consortium. The RGD has already become the 16th biggest member database of EVA
171 (<http://euroveg.org/eva-database-participating-databases>). Compared to mid-June 2015 (Chytrý et al. 2016), the two
172 national Romanian databases together have nearly tripled the density of available data from the country from 5.2
173 plots/100 km² to 13.1 plots/100 km².

174 The RGD is one of the regional databases established under the umbrella of the Eurasian Dry Grassland Group (EDGG;
175 <http://www.edgg.org/>; Vrahnakis et al. 2013). Other regional databases include the Balkan Dry Grassland Database
176 (BDGD; EU-00-013; <http://bit.ly/2upRrDz>), the German GrassVeg.DE (EU-DE-020; <http://bit.ly/2qgX208>; Dengler et
177 al. 2017), the Nordic-Baltic Grassland Vegetation Database (NBGVd; EU-00-002; <http://bit.ly/2vzz3YT>) and the multi-
178 scale database GrassPlot for high-quality, standardized data from throughout the Palaearctic biogeographic realm (EU-
179 00-003; <http://bit.ly/2qKTQt2>). Together these databases make a major contribution to better data availability of
180 grassland data for a multitude of analyses. They thus help to approach the ideal of a broad-scale vegetation
181 classification of Palaearctic grasslands that is data-driven and consistent (Dengler et al. 2013; Janišová et al. 2016). One
182 first such example is the high-rank classification of Pannonian-Pontic *Festuco-Brometea* communities by Willner et al.
183 (2017), which received data for western Romania from the predecessors of the RGD, similarly emerging more detailed
184 studies can now rely on much more extensive data from the current RGD. Also, for the recent re-classification and
185 parameterisation of EUNIS grassland habitats, the Romanian data from the RGD was essential (Schaminée et al. 2016).

186 Last but not least, we hope this paper contributes to raising the awareness of the RGD as a highly useful source for
187 studies of flora, vegetation and habitats at the national scale, including the development of a national syntaxonomic
188 scheme based on numerical analysis, similar to the achievements of the Czech Republic (Chytrý 2007) and Slovakia
189 (Janišová 2007; Jarolímek & Šibík 2008). Furthermore, the RGD is an excellent source for ecology studies as well, as
190 shown by one of the first data requests from a project intending to evaluate the ecological impact of invasive plant
191 species on Romanian grasslands. The compilation of biodiversity datasets with broad taxonomic and biogeographic
192 extents that the computation of a range of biodiversity indicators is necessary to enable better understanding of

193 historical processes and to project future biodiversity changes (Hudson et al. 2014). To model the future, we need to
194 examine the past (Griffin 2017) therefore the collection and preservation of digitized data is a huge responsibility.
195 When researchers learn of once-neglected data that have been revived and transformed via modern insight, they
196 themselves are more likely to recognize such hidden opportunities (Griffin 2017). The Romanian vegetation database is
197 one of these projects that not only preserves historical data, but at the same time also offers the opportunity for various
198 broader scientific purposes and activity that will benefit humankind.

199 **Author contributions**

200 K.V. and E.R., Deputy-custodian and Custodian of the RGD, carried out the major part of the data digitalization and
201 standardization, while S.M.H. and I.K. helped with database management. Except the latter two, all authors contributed
202 published or unpublished data in electronic or printed format. This report was drafted by K.V. with major input by E.R.
203 and J.D., while all co-authors checked, improved and approved the manuscript before submission.

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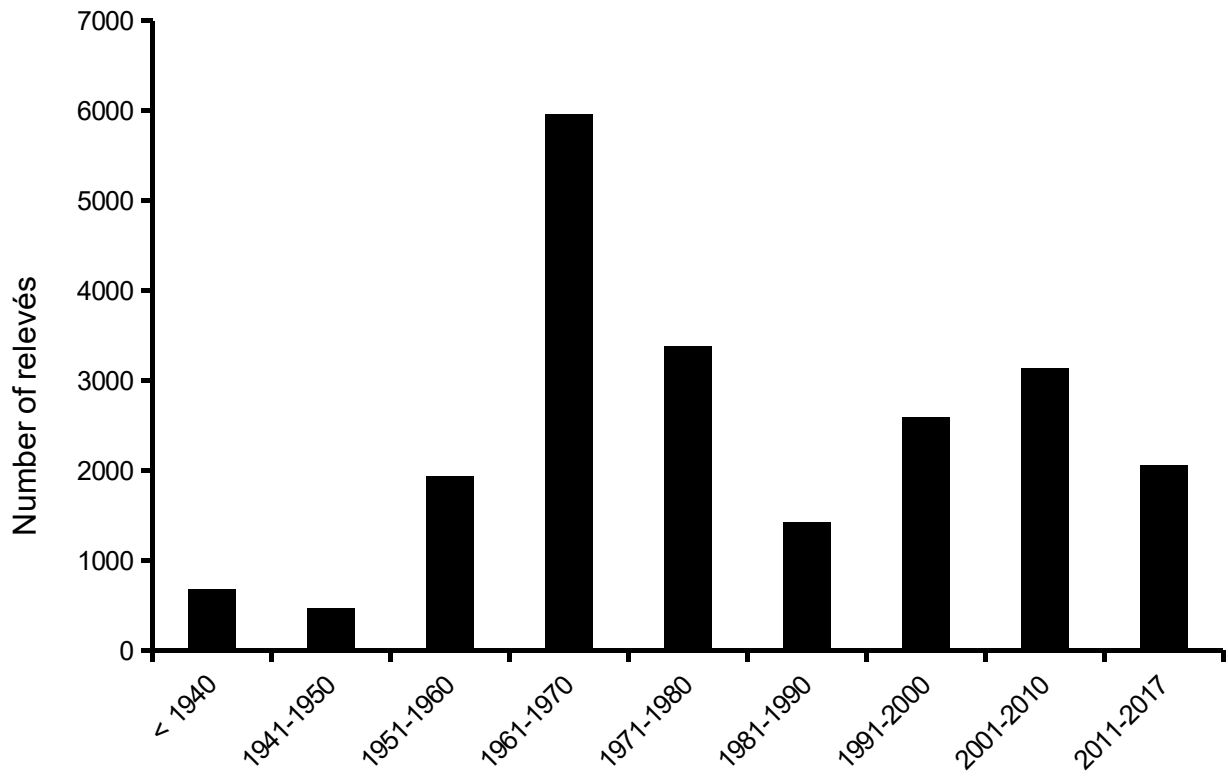
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367 **Electronic Supplements**

368 Supplementary material associated with this article is embedded in the article’s pdf. The online version of
369 Phytocoenologia is hosted at www.ingentaconnect.com/content/schweiz/phyt and the journal’s website
370 www.schweizerbart.com/journals/phyto. The publisher does not bear any liability for the lack of usability or correctness
371 of supplementary material.

372 Supplement S1: Data Property and Governance Rules of RGD.

373 Supplement S2: List of publications and other sources currently included in RGD.



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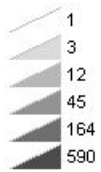
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Fig. 1. Temporal distribution of relevés currently contained in the Romanian Grassland Database.



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380 **Fig. 2.** Spatial distribution of the vegetation plots currently contained in the Romanian Grassland Database, shown as
381 density of plots with geographic coordinates in square grids of 100 km².

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383 **Table 1.** Frequency of different phytosociological classes among the relevés in the Romanian Grassland Database,
 384 grouped into several broad types. Statistics are based on the 17,747 relevés that currently have a phytosociological
 385 assignment. The typology of classes follows Sanda et al. (2008).

Code	Class name	Number of orders	Number of alliances	Number of associations & communities	Number of relevés
01	<i>Lemnetea</i>	3	4	12	400
02	<i>Charetea fragilis</i>	2	5	8	99
04	<i>Ruppietea maritimae</i>	-	-	-	4
05	<i>Potamogenetea pectinati</i>	2	4	23	560
06	<i>Littorelletea uniflorae</i>	1	1	1	12
07	<i>Isoeto-Nanojuncetea</i>	2	2	7	59
08	<i>Phragmito-Magnocaricetea</i>	5	6	43	1,584
09	<i>Montio-Cardaminetea</i>	1	3	7	215
10	<i>Scheuchzerio-Caricetea nigrae</i>	3	5	14	574
11	<i>Oxycocco-Sphagnetea</i>	1	1	2	71
Total	Wetland vegetation	20	31	117	3,578
12	<i>Festucetea vaginatae</i>	1	3	6	131
13	<i>Puccinellio-Salicornietea</i>	3	6	22	566
14	<i>Juncetea maritimi</i>	1	2	4	55
16	<i>Ammophiletea</i>	1	1	2	11
23	<i>Nardo-Callunetea</i>	1	2	4	764
27	<i>Molinio-Arrhenatheretea</i>	4	9	38	2,256
28	<i>Festuco-Brometea</i>	4	9	46	2,582
29	<i>Koelerio-Corynepherea</i>	3	3	7	125
35	<i>Trifolio-Geranietea sanguinei</i>	2	3	4	80
Total	Grassland vegetation of lowlands	20	38	133	6,570
19	<i>Asplenieta trichomanis</i>	3	7	22	569
20	<i>Thlaspietea rotundifolii</i>	3	4	16	415
21	<i>Salicetea herbaceae</i>	2	3	12	299
22	<i>Juncetea trifidi</i>	2	2	8	896
24	<i>Carici rupestris-Kobresietea bellardi</i>	1	1	2	44
25	<i>Seslerietea albicantis</i>	1	3	13	753
26	<i>Betulo-Adenostyletea</i>	1	3	12	321
Total	Subalpine and alpine vegetation	13	23	85	3,297
15	<i>Cakiletea maritimae</i>	2	2	5	43
18	<i>Bidentetea tripartiti</i>	1	2	8	142
30	<i>Stellarietea mediae</i>	4	13	27	966
31	<i>Plantaginetea majoris</i>	1	3	6	180
32	<i>Artemisietea vulgaris</i>	3	7	25	449
33	<i>Galio-Urticetea</i>	2	5	17	298
34	<i>Epilobietea angustifolii</i>	2	3	7	206
Total	Ruderal and segetal vegetation	15	35	95	2,284
36	<i>Salicetea purpureae</i>	2	4	5	22

37	<i>Alnetea glutinosae</i>	2	2	2	21
38	<i>Quercu-Fagetea</i>	1	2	9	82
39	<i>Quercu pubescenti-petreae</i>	1	3	6	146
40	<i>Rhamno-Prunetea</i>	1	2	2	50
41	<i>Erico-Pinetea</i>	1	1	1	26
42	<i>Vaccinio-Piceetea</i>	5	7	12	764
Total	Woodland vegetation	13	21	37	1,111
Total	Cryptogam-dominated vegetation	-	-	-	907
	Grand total	81	148	467	17,747

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