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The third report on the conservation status of habitats (Directive 92/43/EEC) in Italy: processes, methodologies, results and comments

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Abstract

We present the third report (2007-2012) on the conservation status of habitats in Italy, made according to Art. ex 17 of Directive 92/43/EEC. We describe, analyze and comment the data relating to the distribution and conservation status of terrestrial habitats on the Italian territory and for each biogeographic region. These data are affected by the scale of investigation planned by the European Union and by the lack of consistent and objective information methods; however they allow to obtain a view of biodiversity in Italy, although incomplete, and provide a valuable guidance for developing environment's protection and management policies. The large amount of information collected is an important source of georeferenced data with information on the distribution and habitat trends. The analysis of the habitats distribution shows that the largest number of habitats is mainly located in mountainous areas. The reporting data offer a snapshot of the Italian territory characterized by a biodiversity of habitats well distributed throughout the country and in particular in the Natura 2000 sites. The conservation status of habitats is not always satisfactory. Additional long-term monitoring programs are needed, at local, regional or sub-regional scales to allow administrators to properly manage the focal points of their territories. We also propose to make changes in the Habitats Directive increasing the number of habitats to be protected and reassigning the priority of the same at national and sub-national level. We also propose to identify, inside the biogeographical regions, subsectors with a major ecological significance which can be more useful to interpret the habitats. Finally we consider the fragility of many habitats subjected to the effects of global warming and of urban and infrastructure development.

Key words: changes in the Habitats Directive, conservation status of Habitat, Directive 92/43/EEC, distribution of Habitat, global warming, Italy, monitoring of Habitat, Natura 2000 Reporting, third report.

Introduction

The Natura 2000 network, consisting of SCI under the Habitats Directive (92/43/EEC) and SPA under the Birds Directive (2009/147/EC), is the main pillar of Community policy for the conservation of biodiversity in the European Union (Biondi *et al.*, 2012b). The Article 17 of the Habitats Directive includes an obligation on Member States to draw up every six years a report on the implementation of the provisions adopted under the Directive. The first report for the period 1994-2000 was primarily aimed at transposing the Directive into national laws and the identification phase of the Special Areas of Conservation (SAC). The second report (2001-2006) for the first time introduced the evaluation of the conservation status of habitats and species listed in the Directive Annexes. Because of a lack of sufficient and consistent data throughout the national territory in Italy, as in many other EU states, the second report was based only on the Natura 2000 network data (Ministero dell'Ambiente e della Tutela del Territorio e del Mare - Direzione per la Protezione della

Natura, 2008). Despite the publication of guidelines aimed at creating a common methodology between all European countries (European Commission, 2006), the precision and quality of the data provided in the second report and the criteria used to assess the state of conservation of habitats and species were very different in different Member States (European Topic Centre on Biological Diversity, 2009; Sipkova *et al.*, 2010). The experience gained from these early reports led the EU to produce new guidelines for the reporting format for the 2007-2012 period (Evans & Arvela, 2011) in order to further standardize the data collection methodology, making it comparable between several European countries.

The Italian monitoring of habitats for the third National Report according to art. 17 for the period 2007-2012 was entrusted by the Ministry of Environment and Territory and Preservation of the Sea to the "Istituto Superiore per la Protezione e la Ricerca Ambientale" (ISPRA), with contributions from all the Regions and Autonomous Italian Provinces. ISPRA made use of the data collected and processed by the main national

scientific societies that have been directly responsible for the MATTM. Among these, the Italian Botanical Society (SBI) carried out research on terrestrial habitats of Annex I (coordinated by Edoardo Biondi) and the species of Annex II of the Directive (coordinated by Graziano Rossi).

All data of the third National Report of all the Member States, including Italy, are available on line on the Central Data Repository European Environment Agency (EEA) or the relevant page of SINAnet of ISPRA, while further information and documents on art. 17 are located on the site of the European Commission (see more at <http://www.minambiente.it/pagina/monitoraggio-e-rendicontazione#sthash.RW0Kv2Ls.dpuf>). In this article we describe, analyze and comment the data relating to the distribution and conservation status of terrestrial habitats of Directive 92/43/EEC (Biondi *et al.*, 2014). Marine habitats and species included in Directive (Annexes I, II, IV) are not considered. The data used are affected by the lack of consistent information on the distribution of habitats throughout the national territory (especially outside the Natura 2000 network) and objective methods in order to assess their condition.

Methodology

The project started activating the process of finding information available for the Italian territory by involving both the Administration of the Regions and Autonomous Provinces that the experts of the scientific community, in particular the Italian Botanical Society (SBI) and the Italian Society of Science of Vegetation and Landscape (SISV). The data obtained have been used to fill in the reporting format defined by the EC for the period 2007-2012 (European Commission, 2011), following the official guidelines (Evans & Arvela, 2011). The reporting format provides for each of the habitats of the Directive a survey at three levels of detail: national, biogeographical region and within the Natura 2000 Network. A distribution map and a range map are required for the entire national territory. For each biogeographical region are required several useful data to evaluate the final status of conservation of habitats. An example of these data is the current habitat area to be compared with the data of the previous report, so as to define the trend, and with the ideal reference surface. Other information required are threats and pressures to which the habitat is subjected and its typical species. Finally the required data at the Natura 2000 network level relate to the habitat area within the sites and the conservation measures implemented. Data on habitats within the Natura 2000 network can be directly found in the standard forms of individual sites, despite out of date. Outside the Natura 2000 network rather homogeneous data are not avail-

able. We thus needed to consult local scientific experts, both for the assessment of the presence of individual habitats in the different areas that for the evaluation of their conservation status.

To produce the distribution maps of habitats throughout the Italian country, we used not only the data of the Natura 2000 network (ftp://ftp.dpn.minambiente.it/Natura2000/TrasmissioneCE_2013/) but also data from "Carta della Natura" Project at 1: 50.000 (ISPRA, 2009), referred to 10 Italian regions: Valle d'Aosta (Morra di Cella *et al.*, 2008), Veneto (Brentan *et al.*, 2008), Friuli Venezia Giulia (Oriolo *et al.*, 2007), Umbria (White *et al.*, 2012), Lazio (Box *et al.*, 2008), Abruzzo (ISPRA, 2011), Molise (ISPRA, 2005), Puglia (Angelini *et al.*, 2012), Sardinia (Camarda *et al.*, 2011), Sicily (Papini *et al.*, 2006). We also used the data relating to the physiognomy of vegetation obtained from Corine Land Cover land use map at the fourth level of detail (downloadable from www.sinanet.isprambiente.it/Members/mais/Corine/site). These data were superimposed on the map of the series of vegetation of Italy (Blasi, 2010) in order to more precisely locate the habitats which are then identified not only according to the physiognomy of vegetation but also on the basis of the potential vegetation of the territory. We also considered the maps (of different origin and type) produced by regional governments. For example, the Marche Region produced maps of habitats, vegetation and vegetation series inside the SCI and SPA of its territory (<http://www.ambiente.marche.it/Ambiente/Natura/ReteNatura2000/Cartografia.aspx>). Those maps were obtained with the project "Ecological Network of the Marche Region" (REM) (Biondi *et al.*, 2007), which also led to the production of a map of the vegetation of the entire region at the scale 1: 50,000 (Catorci *et al.*, 2007). The Tuscany Region also created a regional ecological network consisting of all of the sites belonging to the Natura 2000 network and the regional sites (SIR) (<http://www.regione.toscana.it/enti-e-associazioni/ambiente/biodiversita>) connected to the naturalistic repertoire of Tuscany (RE.NA.TO). This database, started in 2007 and regularly updated, contains data on species of flora and terrestrial fauna, rare or threatened habitats of regional and community interest, plant communities of special scientific interest (<http://www.regione.toscana.it/-/access-to-information-directory-of-nature-Tuscan>).

Other data on territories sometimes of little extension were retrieved from the literature. Finally, for many habitats we referred to the knowledge and judgment of experts in the field.

When the lack of information provided by the competent regional Authorities (especially for areas outside Natura 2000 sites) was insuperable, we were resorted to various solutions to fill the most obvious gaps, such as consulting phytosociological maps, after

proper assessment correspondence with Natura 2000 habitats codes (e.g. Prov. Aut. Bolzano-Alto Adige). These data obtained by overlapping between different maps were subjected to inspections on the basis of expert assessments.

As required by the reporting format for the distribution of species, distribution maps of habitats were created with reference to a grid of cells 10 x10 km (100 km²) in the reference system ETRS 1989 LAEA. For the interpretation of habitats we followed the Italian manual available online (<http://vnr.unipg.it/habitat/>) updated to March 27, 2013 (Biondi & Blasi, 2009; Biondi *et al.*, 2012a; Biondi, 2013).

Overlaying with software ArcGIS 9.8 the distribution maps of all the habitats on Italian territory, we counted the number of habitats of community interest present in each cell in Italy. For these calculations we considered not only the terrestrial but also the marine habitats, in order to have a complete estimate of how biodiversity is distributed throughout the Italian territory. This analysis was also made considering only the priority habitats, both in absolute numbers and as a percentage of total habitats. Considering in percentage the number of cells containing the same amount of habitats, we produced the graph expressing the cumulative percentage frequency of cells that host the same number of habitats of community interest.

We also analyzed data by grouping the habitats in the 9 macrocategories identified by the European Union (European Commission, 2013), both on the Italian territory and in each biogeographic region. Then we analyzed the distribution of habitats inside and outside the Natura 2000 network, comparing the number of cells containing habitats inside and outside the network.

Finally, we assigned for each habitat in each biogeographic region a value of conservation status to each of the parameters expected by the reporting format (range, area, structure and functions, future prospects). and through the combination of these values we obtained the overall conservation status of the habitat. Unfortunately there are not detailed previous data that allow a comparison with the past to evaluate the trend of habitat distribution throughout the country and to enable an assessment of the specific structures and functions and the optimal surface that each habitat should have. For this reason the evaluation of the individual parameters of conservation status was mainly based on expert judgment. For each cell we counted the number of habitats with unfavorable conservation status, assessing it as an absolute number and as a percentage for each macrocategory and for each biogeographic region.

Results

Figure 1 represents the number of habitats of Community interest that are in each cell of the Italian terri-

tory, divided according to the biogeographic areas defined by the EU. The number of habitats present with an higher frequency in cells is 4 (observed in 5.94% of the cells), closely followed by the cells with 9 habitats (5.88%); just over 2% of the cells home to more than 30 habitats and only 0.08% reaches the maximum of 39 habitats. Finally, the 2.62% of the total cells has not inside any of the habitats of the Directive. The figure 2 represents the cumulative percentage frequency of cells that host the same number of habitats of Community interest. The trend of the graphic point out that the increase in the number of habitats is quite homogeneous up to 16 habitats for the cell: about 75% of the cells has a number of habitats between 1 and 16. The slope of the graph decreases in particular from 20 habitats per cell as only 15% of the cells has a greater number of 20 habitats.

In figure 3 we analyzed only the habitats of priority interest, represented as absolute number (Fig . 3a) or as a percentage of all the habitats of Community interest (Fig . 3b). 9% of the cells not even host a priority habitat, 20% of the cells is home to one and about 70% of the cells has a number of priority habitats between

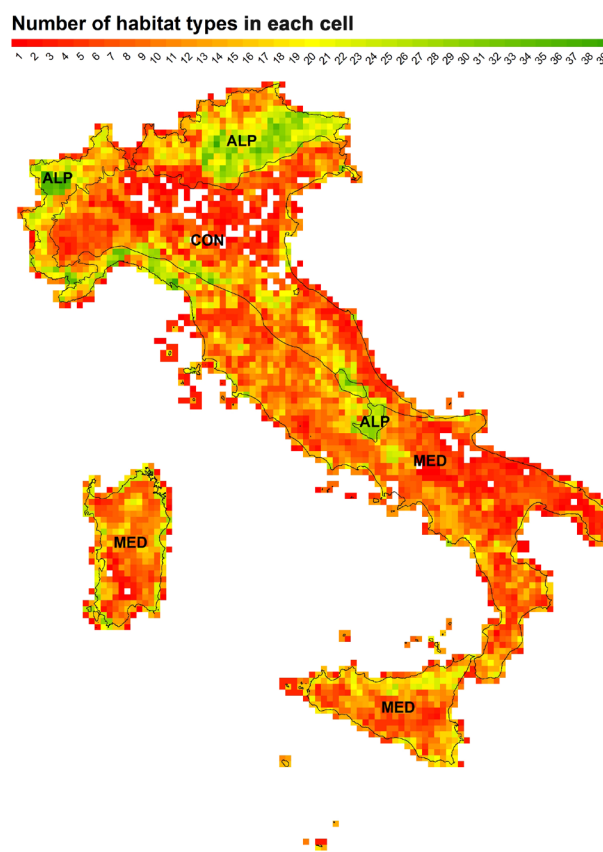


Fig. 1 - Number of habitats of Community interest that are in each cell of 10x10 km of the Italian territory. ALP : Alpine biogeographical region, CON: Continental biogeographical region, MED: Mediterranean biogeographical region. In these analyzes we included also marine habitats.

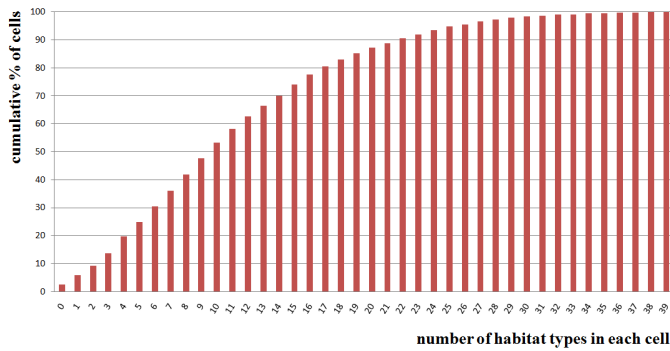


Fig. 2 - Cumulative percentage frequency of cells of 10x10 km with the same number of habitats.

1 and 4.

Table 1 shows the data referred to all habitats together and separately for each macrocategory. Since the total number of cells (second row in the table) represents the sum of the cells where we can find each habitat belonging to the same macrocategory, a cell that houses more of a habitat of the same macrocategory is counted more times. This value therefore depends on both the distribution of individual habitat that the number of habitats included in the macrocategory (first row). The number of cells with at least a habitat of a macrocategory (third row) expresses the general distribution of habitats with similar physiognomy (same

macrocategory). In the fourth row of table 1 this value is expressed as a percentage of the total number of cells of the entire Italian territory or in each biogeographic region.

More than 97% of the cells that represent the Italian territory is occupied by at least one habitat of the Directive. A separate analysis of habitats included in each macrocategory shows that in Italy the forests (macrocategory 9) are represented by the largest number of habitats and distribution cells. 91.1% of the Italian territory cells are occupied by forest habitats: this percentage rises to 96.6% in the Alpine region and down to 87.4% in the Continental, where it is still the highest percentage compared to the other macrocategories. Grassland habitats of macrocategory 6 "Natural and semi-natural grassland formations" have an high coverage too, covering 83.7% of the Italian cells. At the national level the macrocategories with the lowest percentage of coverage are those related to coastal environments: the 2 "Coastal, sand dunes and inland dunes" with 13.0% and 1 "Coastal and halophytic habitats" with 21.2%.

The grassland habitats (macrocategory 6) have the highest average number of distribution cells for each type of habitat (544): this high average value primarily involves the priority habitats 6210(*) "Semi-natural dry grasslands and scrubland facies on calcareous

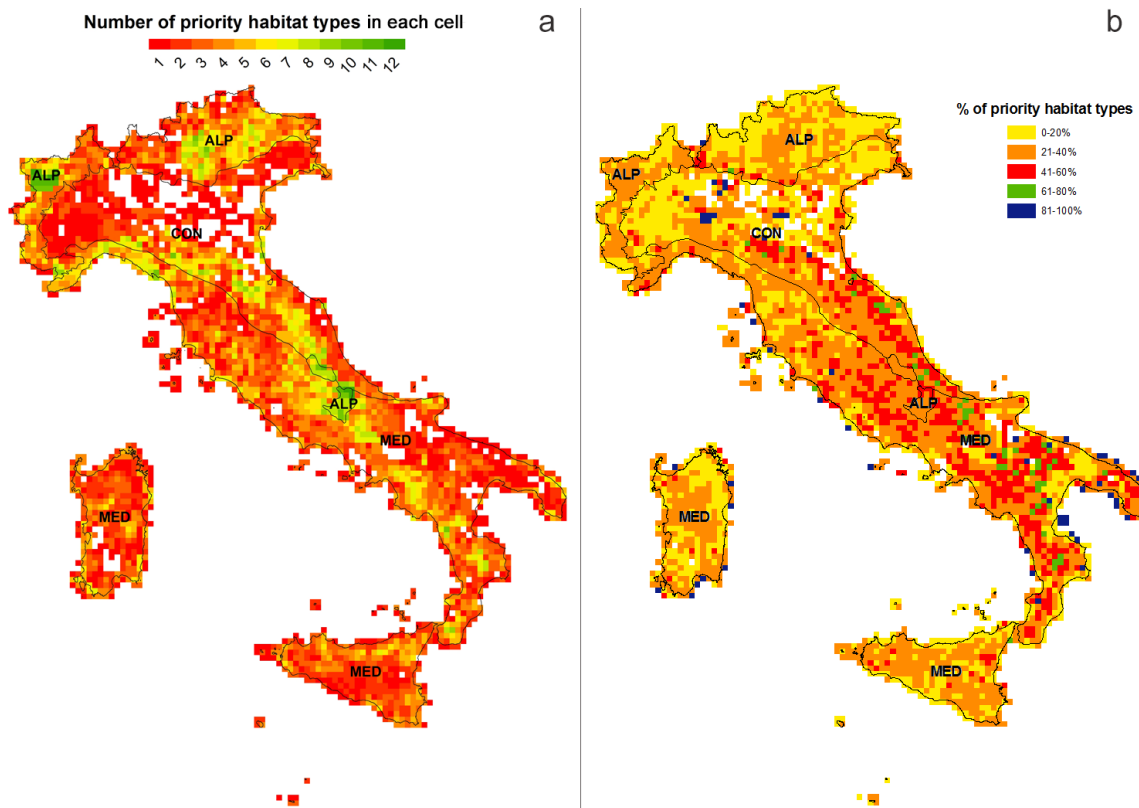


Fig. 3 - a) Number of habitats of priority interest that are in each cell of 10x10 km of the Italian territory. b) Percentage of habitats of priority interest compared with all the habitats of Community interest that are in each cell. ALP : Alpine biogeographical region, CON: Continental biogeographical region, MED: Mediterranean biogeographical region. In these analyzes we included also marine habitats.

Tab. 1 - Number of habitats, the total number of cells, number and percentage of cells with at least one habitat of the total cells of the whole Italian territory and for each biogeographical region, calculated separately for each macrocategory and all habitats. In these analyzes we included also marine habitats. Macrocategory 1= Coastal and halophytic habitats; 2= Coastal, sand dunes and inland dunes; 3= Freshwater habitats; 4= Temperate heath and scrub; 5= Sclerophyllous scrub (matorral); 6= Natural and semi-natural grassland formations; 7= Raised bogs and mires and fens; 8= Rocky habitats and caves; 9= Forests .

macrocategory	1	2	3	4	5	6	7	8	9	tot habitat
Italia										
N habitat	16	11	15	5	11	14	8	11	40	131
tot. num. of cells	1880	1859	4699	1372	2218	7934	1292	4272	13348	
num. of cells with at least one habitat	740	454	2042	910	1521	2924	755	1688	3184	3393
% of cells with at least one habitat	21.2	13.0	58.4	26.0	43.5	83.7	21.6	48.3	91.1	97.1
Alpine region										
N habitat	0	1	13	5	4	14	8	9	30	84
tot. num. of cells	0	1	1373	932	153	3003	837	2203	3555	
num. of cells with at least one habitat	0	1	507	529	131	655	408	577	657	680
% of cells with at least one habitat	0.0	0.1	74.6	77.8	19.3	96.3	60.0	84.9	96.6	100.0
Continental region										
N habitat	9	10	14	5	7	14	7	9	29	104
tot. num. of cells	283	259	1667	290	318	2330	293	665	3289	
num. of cells with at least one habitat	111	77	679	229	291	789	206	263	902	960
% of cells with at least one habitat	10.8	7.5	65.8	22.2	28.2	76.5	20.0	25.5	87.4	93.0
Mediterranean region										
N habitat	7	8	15	5	11	14	6	10	34	110
tot. num. of cells	1609	1606	2142	316	1884	3768	320	1892	7670	
num. of cells with at least one habitat	626	377	1037	275	1215	1710	244	998	1871	1999
% of cells with at least one habitat	30.9	18.6	51.1	13.6	59.9	84.3	12.0	49.2	92.3	98.6

substrates (*Festuco-Brometalia* (*important orchid sites)" and 6220* "Pseudo-steppe with grasses and annuals of the *Thero-Brachypodietea*", respectively present in 1,596 and 1,533 cells. The average number of cells of forest habitats is lower than that of grassland habitats, while having the woods a greater total number of cells. In fact, the macrocategory 9 includes both habitats well distributed throughout the national territory (as 91AA* "Eastern white oak woods" or 9340 "*Quercus ilex* and *Quercus rotundifolia* forests", respectively present in 1,483 and 1,417 cells), than much more localized habitats that occupy only one or a few cells (for example the habitat 9170 "*Galio-Carpinetum* oak- hornbeam forests" is represented by a single cell and 9350 "*Quercus macrolepis* forests" has only 4 cells). Within each macrocategory, in fact, the number of cells of each habitat can also change very significantly depending on the biogeographical characteristics and specific ecological requirements of the individual habitats (see table 2).

The percent coverage of individual macrocategories changes greatly between the different biogeographical regions (Fig. 4). Leaving out forest and grasslands habitats, where the relative percentages of coverage

are higher in all biogeographical regions, coverage of other macrocategories is different in each region. In the Alpine region the percentage of cells occupied

Tab. 2 - Number of distribution cells for each habitat in each biogeographic region.

HABITAT CODE	ALP	CONT	MED	ITALY	HABITAT CODE	ALP	CONT	MED	ITALY
1210	.	88	499	586	6410	148	135	27	277
1240	.	9	367	376	6420	11	88	216	292
1310	.	54	166	218	6430	356	304	262	822
1320	.	22	.	22	6510	311	393	237	791
1340	.	3	.	3	6520	366	161	44	493
1410	.	50	189	237	6	3003	2330	3768	8153
1420	.	45	159	202	7110	81	6	3	87
1430	.	8	168	173	7120	5	6	.	8
1510	.	4	61	63	7140	195	43	49	263
1	0	283	1609	1880	7150	60	31	21	92
2110	.	47	297	343	7210	27	61	49	120
2120	.	37	232	268	7220	122	88	122	290
2130	.	31	.	31	7230	264	58	76	349
2160	.	7	.	7	7240	83	.	.	83
2210	.	.	190	190	7	837	293	320	1292
2230	.	47	272	318	8110	324	27	25	354
2240	.	16	154	169	8120	335	36	48	379
2250	.	27	193	219	8130	180	95	217	414
2260	.	4	113	116	8210	411	166	743	1216
2270	.	37	155	191	8220	325	81	174	531
2330	1	6	.	7	8230	142	85	78	259
2	1	259	1606	1859	8240	138	39	68	195
3110	4	6	1	8	8310	194	131	491	727
3120	.	.	65	65	8320	.	.	43	43
3130	199	173	118	466	8340	154	5	5	154
3140	88	107	127	281	8	2203	665	1892	4272
3150	219	357	250	743	9110	295	147	94	447
3160	28	9	8	40	9120	4	20	21	32
3170	20	36	283	318	9130	281	43	10	291
3220	300	96	11	366	9140	84	6	1	84
3230	82	15	1	93	9150	146	22	8	154
3240	280	282	74	528	9160	69	155	17	193
3250	.	38	433	464	9170	1	.	.	1
3260	91	223	188	443	9180	317	155	130	503
3270	36	256	116	366	9190	11	30	.	30
3280	24	55	274	317	91AA	74	379	1158	1483
3290	2	14	193	201	91B0	.	7	46	52
3	1373	1667	2142	4699	91D0	59	2	.	59
4030	45	170	116	271	91E0	377	506	244	989
4060	457	67	83	544	91F0	53	208	125	340
4070	223	14	3	223	91H0	64	14	.	68
4080	198	8	2	198	91K0	153	25	.	153
4090	9	31	112	136	91L0	107	202	284	485
4	932	290	316	1372	91M0	1	78	570	611
5110	22	11	43	59	9210	52	150	413	533
5130	110	262	250	512	9220	13	41	90	124
5210	16	10	244	265	9250	.	.	34	34
5220	.	.	7	7	9260	335	405	657	1204
5230	.	3	72	75	92A0	60	461	954	1364
5310	.	5	1	6	92C0	.	.	45	45
5320	.	3	175	178	92D0	.	.	513	513
5330	5	24	940	964	9320	.	.	254	254
5410	.	.	20	20	9330	2	.	367	367
5420	.	.	31	31	9340	50	182	1265	1417
5430	.	.	101	101	9350	.	.	4	4
5	153	318	1884	2218	9380	.	.	41	41
6110	108	192	202	425	9410	359	5	2	360
6130	2	10	37	43	9420	432	14	4	432
6150	368	28	10	386	9430	71	3	1	73
6170	453	124	121	587	9510	17	8	30	40
6210	347	506	925	1596	9530	59	9	44	100
6220	46	230	1320	1533	9540	5	10	209	210
6230	360	84	98	464	9560	4	2	3	7
6240	50	1	.	50	9580	.	.	21	21
62A0	77	74	94	219	95A0	.	.	11	11
6310	.	.	175	175	9	3555	3289	7670	13129

by habitats of the macrocategory 8 "Rocky habitats and caves" rises to nearly 85% (this presence at the national level is 48%). Even temperate shrublands of the macrocategory 4 and habitats of inland waters of the macrocategory 3 have an high percent coverage in the Alpine region. The bogs of the macrocategory 7 go up to 60% against a national coverage of 21.6%. The macrocategories 1 and 2, more typically coastal, have instead markedly reduced percentage covers or almost null. In the Continental region, in 7% of the cells are not found habitat. Under these conditions increases the relative importance of freshwater habitats of the macrocategory 3, because of the low representativeness of the other habitats, including forests and grasslands. In the Mediterranean region, however, the percentage of macrocategory 5 "Sclerophyllous scrub (matorral)" is higher, as well as that of coastal habitats and dune (macrocategories 1 and 2). On the contrary, the macrocategory with a smaller number of cells in the Mediterranean region is that of the bogs (7).

Though in absolute terms the number of cells containing at least one of the habitats of the Directive is greater in the Mediterranean region (1999, see Table 1), having this region a larger area than the others, as a percentage of the total number of cells in each biogeographical region in the Mediterranean one habitats are less represented than what is observed in the Alpine region, where 100% of the cells home to at least one habitat (Fig. 5). The Alpine biogeographical region, in fact, while covering a smaller area than the other two regions, it is mostly occupied by the mountain areas where human activities have less impact because of the topography of the area. In the Continental region the percentage goes down to 93%, this region including the Po Valley where industrial activities and intensive farming have virtually eliminated almost entirely natural vegetation strips.

If we consider only the cells containing habitats that

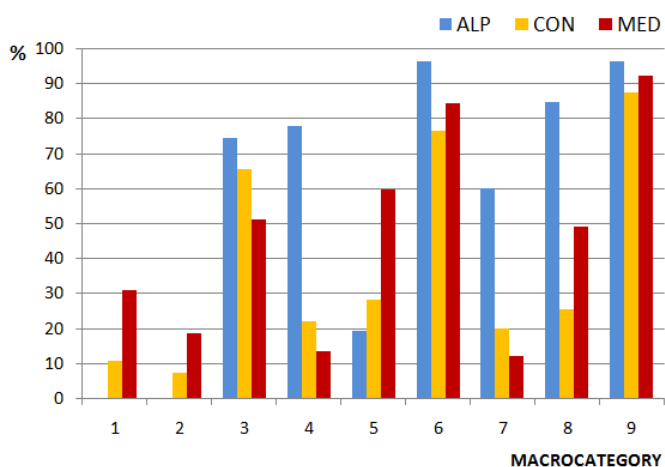


Fig. 4 - Percentage of cells with at least one habitat of each macrocategory for each biogeographical region.

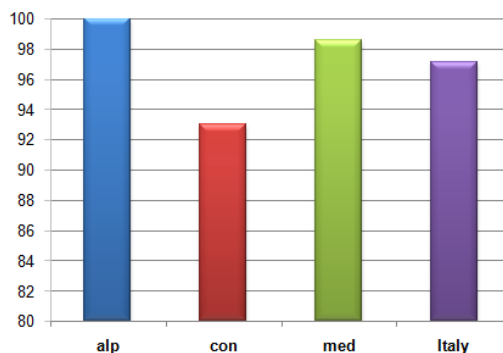


Fig. 5 - Percentage of cells with at least one habitat of the total cells of each biogeographical region and all over the Italian territory.

are present within the Natura 2000 network (SCI and SPA areas), in Italy they account for more of the 80% (80.9%) of all the cells containing habitats that are present on the Italian territory (Tab. 3). 19.1% of the cells with habitats of the Directive (649 cells, to be exact) is then located outside the Natura 2000 network.

As for the conservation status of habitats, Figure 6 shows that the habitats present within the Alpine region are in a worst global conservation status than in other regions: 75% of the habitats within the Alpine region is in an unfavourable conservation status (unfavourable-inadequate = U1 or unfavourable-bad = U2). Even the habitats of the Continental region are not in an excellent conservation status, with 70% in unfavourable conservation status, while in the Mediterranean the percentage of habitats with unfavorable

Tab. 3 - Number and percentage of cells containing habitats inside and outside the Natura 2000 network.

	num.	%
cells with habitat inside Natura2000	2744	80,87
cells with habitat in Italy	3393	100
cells in Italy	3494	

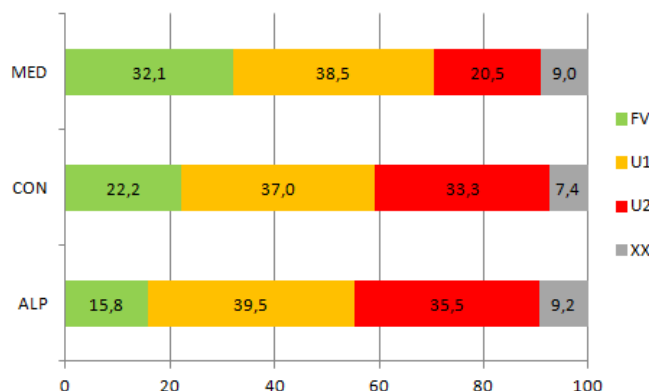


Fig. 6 - Percentage of habitats with different state of global conservation status for each biogeographical region. FV= favourable; U1= unfavourable-inadequate; U2= unfavourable-bad.

conservation status falls further to 59%.

The areas of each biogeographic region with a greater number of habitats in unfavourable conservation status (U1 or U2) are shown in Fig. 7. Tables 4, 5 and 6 set out a list of these habitats for each biogeographic region.

Tab. 4 - Habitats of the Alpine region with unfavourable-inadequate conservation status (U1) or unfavourable-bad conservation status (U2).

HABITAT		Conservation Status
CODE	NAME	
3110	Oligotrophic waters containing very few minerals of sandy plains (Littorelletalia uniflorae)	U2
3130	Oligotrophic to mesotrophic standing waters with vegetation of the Littorelletea uniflorae and/or of the Isoëto-Nanojuncetea	U2
3140	Hard oligo-mesotrophic waters with benthic vegetation of Chara spp.	U1
3150	Natural eutrophic lakes with Magnopotamion or Hydrocharition — type vegetation	U2
3160	Natural dystrophic lakes and ponds	U2
3220	Alpine rivers and the herbaceous vegetation along their banks	U1
3230	Alpine rivers and their ligneous vegetation with Myricaria germanica	U2
3240	Alpine rivers and their ligneous vegetation with Salix elaeagnos	U1
3260	Water courses of plain to montane levels with the Ranunculion fluitantis and Callitriche-Batrachion vegetation	U2
3270	Rivers with muddy banks with Chenopodium rubri p.p. and Bidention p.p. vegetation	U1
4030	European dry heaths	U1
4070	Bushes with Pinus mugo and Rhododendron hirsutum (Mugo-Rhododendretum hirsuti)	U1
4080	Sub-Arctic Salix spp. scrub	U1
5110	Stable xerothermophilous formations with Buxus sempervirens on rock slopes (Berberidion p.p.)	U1
5210	Arborescent matorral with Juniperus spp.	U1
6110	Rupicolous calcareous or basophilic grasslands of the Alyso-Sedion albi	U2
6210	Semi-natural dry grasslands and scrubland facies on calcareous substrates (Festuco-Brometalia) (* important orchid sites)	U1
6230	Species-rich Nardus grasslands, on silicicous substrates in mountain areas (and submountain areas in Continental Europe)	U2
6240	Sub-Pannonic steppic grasslands	U2
62A0	Eastern sub-Mediterranean dry grasslands (Scorzoneratalia villosae)	U2

6410	Molinia meadows on calcareous, peaty or clayey-silt-laden soils (Molinia caeruleae)	U2
6430	Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels	U1
6510	Lowland hay meadows (Alopecurus pratensis, Sanguisorba officinalis)	U2
6520	Mountain hay meadows	U2
7110	Active raised bogs	U2
7140	Transition mires and quaking bogs	U2
7150	Depressions on peat substrates of the Rhynchosporion	U2
7210	Calcareous fens with Cladium mariscus and species of the Caricion davallianae	U2
7220	Petrifying springs with tufa formation (Cratoneurion)	U1
7230	Alkaline fens	U2
7240	Alpine pioneer formations of the Caricion bicoloris-atrofuscae	U2
8130	Western Mediterranean and thermophilous scree	U1
8230	Siliceous rock with pioneer vegetation of the Sedo-Scleranthion or of the Sedo albi-Veronicion dillenii	U1
8310	Caves not open to the public	U1
8340	Permanent glaciers	U2
9110	Luzulo-Fagetum beech forests	U1
9120	Atlantic acidophilous beech forests with Ilex and sometimes also Taxus in the shrublayer (Quercion robori-petraeae or Ilici-Fagenion)	U1
9130	Asperulo-Fagetum beech forests	U1
9140	Medio-European subalpine beech woods with Acer and Rumex arifolius	U1
9150	Medio-European limestone beech forests of the Cephalanthero-Fagion	U1
9160	Sub-Atlantic and medio-European oak or oak-hornbeam forests of the Carpinion betuli	U2
9170	Galio-Carpinetum oak-hornbeam forests	U2
9180	Tilio-Acerion forests of slopes, screes and ravines	U2
91D0	Bog woodland	U1
91E0	Alluvial forests with Alnus glutinosa and Fraxinus excelsior (Alno-Padion, Alnion incanae, Salicion albae)	U2
91F0	Riparian mixed forests of Quercus robur, Ulmus laevis and Ulmus minor, Fraxinus excelsior or Fraxinus angustifolia, along the great rivers (Ulmion minoris)	U2
91H0	Pannonian woods with Quercus pubescens	U2
91K0	Illyrian Fagus sylvatica forests (Arenonio-Fagion)	U1
91L0	Illyrian oak-hornbeam forests (Erythronio-Carpinion)	U2
9260	Castanea sativa woods	U1
92A0	Salix alba and Populus alba galleries	U1
9340	Quercus ilex and Quercus rotundifolia forests	U1
9410	Acidophilous Picea forests of the montane to alpine levels (Vaccinio-Piceetea)	U1
9430	Subalpine and montane Pinus uncinata forests (* if on gypsum or limestone)	U1
9510	Southern Apennine Abies alba forests	U1
9530	(Sub-) Mediterranean pine forests with endemic black pines	U1
9560	Endemic forests with Juniperus spp.	U1

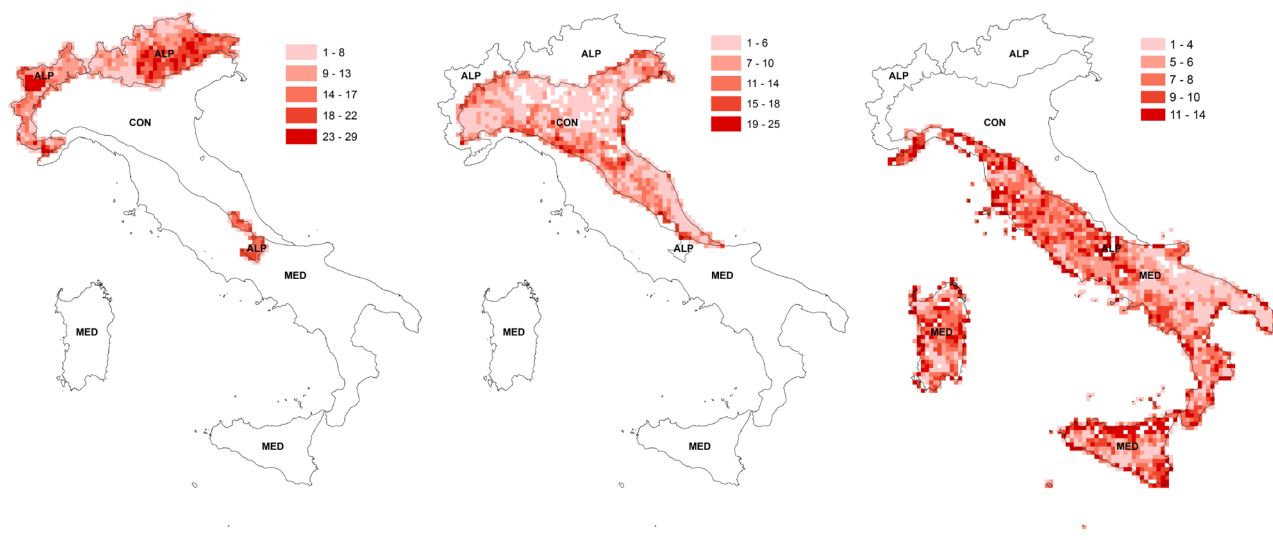


Fig. 7 - Number of habitats with Unfavorable Conservation Status (U1 or U2) in each cell of each biogeographic region.

Tab. 5 - Habitats of the Continental region with unfavourable-inadequate conservation status (U1) or unfavourable-bad conservation status (U2).

HABITAT		Conservation Status
CODE	NAME	
1210	Annual vegetation of drift lines	U1
1310	Salicornia and other annuals colonizing mud and sand	U1
1320	Spartina swards (Spartinion maritimae)	U2
1340	Inland salt meadows	U1
1410	Mediterranean salt meadows (Juncetalia maritimi)	U2
1420	Mediterranean and thermo-Atlantic halophilous scrubs (Sarcocometea fruticosi)	U1
2110	Embryonic shifting dunes	U2
2120	Shifting dunes along the shoreline with Ammophila arenaria ('white dunes')	U2
2130	Fixed coastal dunes with herbaceous vegetation ('grey dunes')	U2
2160	Dunes with Hippophaë rhamnoides	U2
2230	Malcolmietalia dune grasslands	U2
2250	Coastal dunes with Juniperus spp.	U2
2260	Cisto-Lavenduletalia dune sclerophyllous scrubs	U2
2330	Inland dunes with open Corynephorus and Agrostis grasslands	U2
3110	Oligotrophic waters containing very few minerals of sandy plains (Littorelletalia uniflorae)	U2
3130	Oligotrophic to mesotrophic standing waters with vegetation of the Littorelletalia uniflorae and/or of the Isoëto-Nanojuncetalia	U2
3140	Hard oligo-mesotrophic waters with benthic vegetation of Chara spp.	U1
3150	Natural eutrophic lakes with Magnopotamion or Hydrocharition — type vegetation	U2
3170	Mediterranean temporary ponds	U2
3220	Alpine rivers and the herbaceous vegetation along their banks	U1
3230	Alpine rivers and their ligneous vegetation with Myricaria germanica	U2
3240	Alpine rivers and their ligneous vegetation with Salix elaeagnos	U1
3260	Water courses of plain to montane levels with the Ranunculion fluitantis and Callitriche-Batrachion vegetation	U2
3270	Rivers with muddy banks with Chenopodium rubri p.p. and Bidentation p.p. vegetation	U1
4030	European dry heaths	U1
5110	Stable xerothermophilous formations with Buxus sempervirens on rock slopes (Berberidion p.p.)	U1
5210	Arborescent matorral with Juniperus spp.	U1
5310	Laurus nobilis thickets	U1
6110	Rupicolous calcareous or basophilic grasslands of the Alysso-Sedion albi	U1
6150	Siliceous alpine and boreal grasslands	U1
6210	Semi-natural dry grasslands and scrubland facies on calcareous substrates (Festuco-Brometalia) (* important orchid sites)	U1
6220	Pseudo-steppe with grasses and annuals of the Thero-Brachypodietea	U1
6230	Species-rich Nardus grasslands, on silicious substrates in mountain areas (and submountain areas in Continental Europe)	U1
62A0	Eastern sub-Mediterranean dry grasslands (Scorzoneratalia villosae)	U2
6410	Molinia meadows on calcareous, peaty or clayey-silt-laden soils (Molinion caeruleae)	U1
6420	Mediterranean tall humid grasslands of the Molinio-Holoschoenion	U1
6510	Lowland hay meadows (Alopecurus pratensis, Sanguisorba officinalis)	U1
6520	Mountain hay meadows	U2
7140	Transition mires and quaking bogs	U2
7150	Depressions on peat substrates of the Rhynchosporion	U2
7210	Calcareous fens with Cladium mariscus and species of the Caricion davallianae	U2
7220	Petrifying springs with tufa formation (Cratoneurion)	U1
7230	Alkaline fens	U2
5		
8310	Caves not open to the public	U1
1		
9130	Asperulo-Fagetum beech forests	U1

9180	Tilio-Acerion forests of slopes, screes and ravines	U1
9190	Old acidophilous oak woods with Quercus robur on sandy plains	U2
91AA	Eastern white oak woods	U2
91B0	Thermophilous Fraxinus angustifolia woods	U2
91E0	Alluvial forests with Alnus glutinosa and Fraxinus excelsior (Alno-Padion, Alnion incanae, Salicion albae)	U2
91F0	Riparian mixed forests of Quercus robur, Ulmus laevis and Ulmus minor, Fraxinus excelsior or Fraxinus angustifolia, along the great rivers (Ulmenion minoris)	U2
91L0	Illyrian oak-hornbeam forests (Erythronio-Carpinion)	U1
91M0	Pannonian-Balkan turkey oak –sessile oak forests	U1
9210	Apeninne beech forests with Taxus and Ilex	U1
9260	Castanea sativa woods	U1
92A0	Salix alba and Populus alba galleries	U2
9410	Acidophilous Picea forests of the montane to alpine levels (Vaccinio-Piceetea)	U1
9530	(Sub-) Mediterranean pine forests with endemic black pines	U1
9540	Mediterranean pine forests with endemic Mesogean pines	U2

Tab. 6 - Habitats of the Mediterranean region with unfavourable-inadequate conservation status (U1) or unfavourable-bad conservation status (U2).

HABITAT		Conservation Status
CODE	NAME	
1240	Vegetated sea cliffs of the Mediterranean coasts with endemic Limonium spp.	U1
1310	Salicornia and other annuals colonizing mud and sand	U1
1410	Mediterranean salt meadows (Juncetalia maritimi)	U1
1420	Mediterranean and thermo-Atlantic halophilous scrubs (Sarcocometea fruticosi)	U1
1510	Mediterranean salt steppes (Limonietalia)	U2
2110	Embryonic shifting dunes	U2
2120	Shifting dunes along the shoreline with Ammophila arenaria ('white dunes')	U2
2210	Crucianellion maritimae fixed beach dunes	U2
2230	Malcolmietalia dune grasslands	U1
2240	Brachypodietalia dune grasslands with annuals	U1
2250	Coastal dunes with Juniperus spp.	U2
2260	Cisto-Lavenduletalia dune sclerophyllous scrubs	U2
2270	Wooded dunes with Pinus pinea and/or Pinus pinaster	U1
3120	Oligotrophic waters containing very few minerals generally on sandy soils of the West Mediterranean, with Isoetes spp.	U1
3150	Natural eutrophic lakes with Magnopotamion or Hydrocharition — type vegetation	U1
3170	Mediterranean temporary ponds	U1
3250	Constantly flowing Mediterranean rivers with Glaucium flavum	U1
3260	Water courses of plain to montane levels with the Ranunculion fluitantis and Callitriche-Batrachion vegetation	U2
5210	Arborescent matorral with Juniperus spp.	U1
5220	Arborescent matorral with Zyziphus	U2
5230	Arborescent matorral with Laurus nobilis	U1
5330	Thermo-Mediterranean and pre-desert scrub	U1
5410	West Mediterranean cliff-top phryganas (Astragalo-Plantaginietum subulatae)	U2
5430	Endemic phryganas of the Euphorbio-Verbascion	U1
6130	Calaminarian grasslands of the Violetalia calaminariae	U1
6210	Semi-natural dry grasslands and scrubland facies on calcareous substrates (Festuco-Brometalia) (* important orchid sites)	U1
6230	Species-rich Nardus grasslands, on silicious substrates in mountain areas (and submountain areas in Continental Europe)	U1
6310	Dehesas with evergreen Quercus spp.	U1
6410	Molinia meadows on calcareous, peaty or clayey-silt-laden soils (Molinion caeruleae)	U2
6420	Mediterranean tall humid grasslands of the Molinio-Holoschoenion	U1
6430	Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels	U1
6510	Lowland hay meadows (Alopecurus pratensis, Sanguisorba officinalis)	U1
7140	Transition mires and quaking bogs	U1
7210	Calcareous fens with Cladium mariscus and species of the Caricion davallianae	U2
7220	Petrifying springs with tufa formation (Cratoneurion)	U1
7230	Alkaline fens	U1

8310	Caves not open to the public	U1
9180	Tilio-Acerion forests of slopes, screes and ravines	U1
91AA	Eastern white oak woods	U2
91B0	Thermophilous Fraxinus angustifolia woods	U2
91E0	Alnus glutinosa and Fraxinus excelsior (Alno-Padion, Alnion incanae)	U1
91F0	Riparian mixed forests of Quercus robur, Ulmus laevis and Ulmus minor, Fraxinus excelsior or Fraxinus angustifolia, along the great rivers (Ulmion minoris)	U2
91L0	Illyrian oak-hornbeam forests (Erythronio-Carpinion)	U1
91M0	Pannonian-Balkan turkey oak –sessile oak forests	U1
9250	Quercus trojana woods	U1
9260	Castanea sativa woods	U1
92A0	Salix alba and Populus alba galleries	U2
92C0	Platanus orientalis and Liquidambar orientalis woods (Platanion orientalis)	U1
92D0	Southern riparian galleries and thickets (Nerio-Tamaricetea and Securion tinctoriae)	U1
9320	Olea and Ceratonia forests	U1
9330	Quercus suber forests	U1
9340	Quercus ilex and Quercus rotundifolia forests	U1
9350	Quercus macrolepis forests	U2
9380	Forests of Ilex aquifolium	U1
9510	Southern Apennine Abies alba forests	U1
9540	Mediterranean pine forests with endemic Mesogean pines	U1
9580	Mediterranean Taxus baccata woods	U1
95A0	High oro-Mediterranean pine forests	U1

Table 7 makes it possible to detect that in the Alpine region habitats that are found with a higher percentage in an unfavorable conservation status are those of the macrocategory 7 (raised bogs and mires and fens), followed by freshwater habitats (macrocategory 3). In the Continental and Mediterranean regions, however, the habitats most affected by the human impact are those of coastal dunes (macrocategory 2): in the Mediterranean region they are in unfavourable conservation status even in 100% of cases.

Discussion

From the analysis of the distribution of all habitats on the Italian territory we can observe that mountain areas (western Alps, Eastern Alps, Apuan Alps, Central Apennines) are the areas where there is the largest number of habitats. In these areas, in fact, the individual cells include within them considerable altitudinal variations which determine also very different environmental conditions, especially in relation to bioclimatic variations. Even coastal areas are home to a great number of habitats, especially in regions where naturalness of coastal areas has been more preserved (such as Sardinia, Sicily, Tuscany and part of North Adriatic coast). Close to the coast line, in fact, environmental conditions vary within a few meters as one moves away from the sea, resulting in the succession of different habitats, each other in catenal connection, expression of a significant concentration of biodiversity. The cells with no habitats are mainly located in lowland areas, especially in the Po Valley and the “Tavoliere” in Apulia, heavily exploited by intensive agricultural activities and, especially in the Po Valley, by a strong urban and infrastructure development. The

Tab. 7 - Percentage of habitats with unfavorable conservation status for each macrocategory in each biogeographical region.

MACROCATEGORY		% HABITAT with SC Unfavorable		
CODE	NAME	ALP	CON	MED
1	Coastal and halophytic habitats	-	66.7	71.4
2	Coastal sand dunes and inland dunes	0.0	80.0	100.0
3	Freshwater habitats	76.9	71.4	33.3
4	Temperate heath and scrub	60.0	20.0	0.0
5	Sclerophyllous scrub (matorral)	50.0	42.9	54.5
6	Natural and semi-natural grassland	64.3	71.4	57.1
7	Raised bogs and mires and fens	87.5	71.4	66.7
8	Rocky habitats and caves	44.4	11.1	10.0
9	Forests	73.3	51.7	61.8

cells that do not host any habitat, however, represent only 2.6%, while those that have more than 20 habitats are about 15% of the total. These data show, therefore, that there is a widespread naturalness on the Italian territory: although most of the peninsula is characterized by hilly morphologies in which the human presence is consistent and agricultural and urbanized areas are uniformly distributed, the habitats of conservation importance are well represented. These data highlight, at least at the used survey scale, an interpenetration of the natural elements in anthropic landscape that makes Italy a country with high biodiversity.

The distribution of habitats with priority importance is similar to that observed for habitats of Community importance. The areas that are home to the largest number of priority habitats are the Valle d'Aosta and the central Apennines in Abruzzo, where even the total number of habitats is greater. However, considering the proportion of priority habitats of all habitats of Community interest may be observed that the most exclusive areas for priority habitats are coastal, mainly thanks to the presence of habitat 1120* "*Posidonia* beds (*Posidonium oceanicae*)" that is 100% of all EU habitats. The high percentage of priority habitats in some cells located in the Po Valley is due instead to the only presence of the habitat 91E0* "Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion*, *Alnion incanae*, *Salicion albae*)", whose subtype 44.13 "White willow gallery forests (*Salicion albae*)" has in the Po valley its southern distribution limit in Italy (Biondi *et al.*, 2009).

The analysis of the distribution of macrocategories shows that in Italy the habitats with greater percentage of distribution are the forests and the grasslands. Even shrubby habitats are well represented, although their percentage coverage is separated into the two macrocategories (4 and 5); the Habitats Directive, in fact, distinguishes temperate shrublands from Mediterranean ones, more due to ecological reasons than to physiognomic reasons. The observed good balance between coverage of grassland habitats, shrubs and forests leads to good values of biodiversity in the Italian territory. Unfortunately, in recent years the cover of shrub and tree vegetation is increasing at the expense

of grasslands due to the abandonment of traditional agro-forestry-pastoral practices and the establishment of the evolutionary dynamics of the vegetation (Biondi, 2008; Biondi, 2009; Galdenzi *et al.*, 2012). The largest area occupied by grassland, shrub and forest habitats is due to ecological and structural characteristics of these habitats, generally less related to small environments as are coastal habitats of macrocategories 1 and 2, and those related to wet environments (macrocategories 3 and 7).

Due to the geomorphological features of the territory, in the Alpine region increases the coverage of the rocky habitats, strongly linked to mountain areas, as well as that of temperate shrubs habitats related to inland waters and peat bogs, thus underlining the strong link of these environments to Alpine region. The rugged morphology of the Alpine region caused a less exploitation of this territory by human activities and this is reflected in the presence of at least one habitat of the Directive to all the cells in the region. However, these habitats are often not in a good conservation status. Especially wet habitats of the macrocategories 7 (peat bogs) and 3 (inland waters) are impacted by anthropogenic and climatic change.

The Continental biogeographical region suffered most from the human impact: the low-hill and plain areas have strongly been affected by consumption of soil by human activities, resulting in an overall low representativeness of the habitats of all the macrocategories, including forest and grassland. The habitats of the Continental region, as well as being under-represented, they are in an unfavourable conservation status in 70% of cases, a percentage that rises to 80% for coastal dune habitats. In the Mediterranean region, although it has also been heavily exploited by human activities, instead there is a widespread presence of natural habitats even favoured from traditional agro-forestry-pastoral activities, such as grassland. The conservation status of these habitats is therefore typically better than in the Continental region, even if 100% of dune coastal habitats are in an unfavourable conservation status. In the Mediterranean region the major human impacts are in fact due to the tourist-beach activities. The rocky habitats are in an unfavorable conservation status in a lesser percentage in all the three biogeographic regions: in fact, they are in general less affected by the impact of human activities.

According to the European biogeographic classification, in Italy Alpine, Continental and Mediterranean biogeographical regions extend respectively for 18%, 29%, and 53% of the territory. The comparison with the bioclimatic map of Italy shows that about 45% of the Continental region and 19% of the Mediterranean region fall within the Temperate macrobioclimate sub-Mediterranean variant. Consequently, the attribution of a habitat to a certain biogeographic region made on

the basis of the Interpretation Manual of European Union Habitats - EUR28 (European Commission, 2013) is more administrative than scientific and, therefore, not fully comprehensive and adequate (Biondi *et al.*, 2015).

Finally, as regards the distribution of habitats within the SCI and SPA areas, a large proportion (over 80%) of the cells containing habitat is located in Natura 2000. It would appear that the Natura 2000 network in Italy, while occupying only 18% of the territory (Rosati *et al.*, 2007), is able to cover the distribution of habitats adequately enough. This assessment, however, must necessarily take account of the methodology which considers cells of 100 km² that can host habitats also only on a small portion of their surface. In addition, it must be considered that in the absence of detailed information, the reconstruction of the data outside Natura 2000 sites can not be complete as within sites.

Concluding remarks

The investigations carried out for completing the reporting format required by Directive 92/43/EEC have been found very useful to have guidance on how biodiversity is distributed on the Italian territory and to assess its conservation status. The survey scale used is appropriate at European level to compare the distribution and amount of habitats present in the different nations of the European Community. Despite the cells used in the distribution maps covering a surface of 100 km² and are therefore not very useful to precisely locate habitats, they can still provide valuable information at the national level to identify the geographical areas of the Italian territory that are more rich of habitats (hot spot of biodiversity) and at the same time to locate areas with less naturalness.

The data of the reporting format offer a snapshot of the Italian territory characterized by a biodiversity sufficiently distributed throughout the territory. It should however be noted that the number of priority habitats in Annex I of the Directive must be increased, by assigning the rank of priority habitats on a regional basis taking into account the different conditions arising from the reports, and then by local monitoring. At the same time it is important to consider also many habitats that currently are not in the Annex I of the Directive even if they are very important on the national level, as proposed by the Italian Botanical Society. The Italian Ministry can propose to insert these habitats in Annex I of the Directive when the European Union will reopen the term for variations (Biondi, 2013).

The analysis of the conservation status of habitats differentiated by biogeographic region has the advantage of allowing a separate assessment of the same habitat that may be subject to different human impacts in the different biogeographical contexts. The internal

biodiversity of a single habitat can vary a lot between different biogeographical regions and often in the border areas between two different regions is observed increased biodiversity due to the presence of species from different biogeographic contexts that in border areas are mixed. This is, for example, the case of the vegetation of the coastal dunes in the North Adriatic, on the border between the Continental and the Alpine region, where it is enhanced by species with alpine distribution (Sburlino *et al.*, 2013). Unfortunately, at present the Habitats Directive does not expect that the allocation of priorities to a habitat is differentiated for biogeographical region or even for the different subtypes of the habitat. It would be desirable for this differentiation in subsequent updates of Annex I of the Directive (Biondi *et al.*, 2014).

The large amount of information collected during the monitoring of habitats in Italy for the third report is an important source of georeferenced data for the first time related to the whole Italian territory. We can start from these data for future monitoring but to update the database it is desirable to have continuous information from experts activated by Italian Regions and Autonomous Provinces that are responsible of environmental resources by delegation from the State (Legislative Decree 3 April 2006, n. 152). The need to have the opinion of the expert, often observed during the collection of data, depended both from vagueness and subjectivity of the method provided by the European Community that the lack of quality and homogeneity of available data. What has been achieved so far is only the starting point of an ongoing process of European biodiversity conservation. It is therefore necessary to stress not only the need for long-term monitoring programs, already expected by the Community directives, but also to start appropriate monitoring programs at local, regional or sub-regional scale with more analytical details and adequate cartographic representations so that administrators can consciously manage the focal points of their territories.

We also need to highlight the lack, in many sectorial experts, of a proper understanding of the concept of habitat which is the true innovation in the field of conservation biology introduced by Directive 92/43/ECC: not by chance this Directive is generically referred to as the Habitats Directive. It is in fact through the conservation and proper management of habitats that it is possible the effective maintenance of most of the species in the ecosystems in which they live (in situ conservation). In research aimed at preservation of the biodiversity, the European Community policy should therefore be more focused to enhance the cognitive logical process of integration of the species in their environment. Such knowledge should indeed be the basis for the realization of the management plans for Natura 2000 sites (article 6 Directive 92/43/EEC)

still being carried out in Italy.

On the plains and in the low hills of Italy, as in all the European Union, intensive agriculture causes the big change and extreme reduction of "agricultural ecosystems". Nearly half (48%) of the bird species associated with agricultural habitats are in a favourable conservation status, and 8% are unfavourable but improved, while 28% are unfavourable and deteriorated. The threats and pressures most frequently reported as considerable for agricultural habitats and species include both intensification and abandonment. (European Environment Agency, 2015). As for flora and vegetation, the practice of weeding, conducted also in the residual areas as well as directly in the fields, produces enormous effects of alteration in agro-ecosystems resulting in soil erosion and groundwater pollution (Taffetani *et al.*, 2003). An important monitoring system of agro-ecosystems was made by Taffetani & Rismondo (2009) and is based on the phytosociological and syndynamical analysis of communities living in different landscape area (Taffetani *et al.*, 2011; Giupponi *et al.*, 2013).

Finally, a fundamental aspect to keep in mind, because it will impact more strongly in the near future, on the conservation of habitats and species, is linked to global warming. The effects of climate change are leading to a transformation of habitats already detectable across species. In fact, biologists are finding evidence of this transformation across a wide range of taxonomic and functional groups. Species are responding to climate change by altering their phenology and geographical distributions (Hickling *et al.* 2006; Lenoir *et al.* 2008). Considering the rapidity of the changes caused by global warming, it is necessary to create conditions so that these species are not forced to emigrate or to become extinct, rebuilding secondary habitats of refuge. Araújo *et al.* (2011) show that nationally designated protected areas would preserve species better than unprotected areas, probably because they tend to occur in mountains, which act as climate refugia. The species of the Natura 2000 network living in the plains next to the coasts are the most vulnerable as they are included in the few surviving areas surrounded by agricultural activities and buildings and, at the same time, are more exposed to the consequences of climate change (Peterson 2003; Loarie *et al.* 2009; Biondi *et al.*, 2012c). The Italian coasts are particularly vulnerable to the effects of global warming. A predictive model relating the effects of the climate change on the Italian coasts (Prisco *et al.* 2013) foretells that without proper management the habitats of the fixed and the mobile dunes may disappear in the short term. In Italy, despite the strong alteration that habitats suffered, a high number of coastal plant communities still occurs. Therefore, it is necessary to carefully manage these habitats and we need to carry out a recovery strategy that would

allow the preservation of ecosystems and thus the improvement of natural areas along the Italian coasts (Biondi *et al.* 2014). This is definitely the priority of the protection of habitats for Italy. The significant loss of biodiversity in coastal areas is also highlighted by diachronic analyzes (Brachetti & Accounts 2014; Del Vecchio *et al.* 2015). The conservation of biodiversity requires approaches as the reclassification of existing conservation areas (Fuller *et al.* 2010) and the designation of new areas, as well as the implementation of mechanisms for the integrated management of the countryside to facilitate movement of species between conservation areas (Biondi *et al.* 2012b).

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