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Classification of Municipalities according to the Italian Ecoregions

Methodological note

Summary

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1. Ecoregions and their potential application; state of the art of the ecoregional classification in Italy

Ecoregions, or ecological regions, are more or less wide portions of land with homogeneous ecological character because of the distinctive interaction between species and natural communities with the physical environment. Therefore, ecoregions are areas with similar ecosystem potential and represent suitable spatial frameworks for investigating ecological processes, disturbance regimes, vegetation distribution and landscape characters.

Worldwide, ecoregions became a tool for addressing sustainable management and development strategies at different scales. Notable examples include:

- analysis of representativeness of protected areas, design of biodiversity conservation strategies and plans, and assessment of forest resources at the global scale;

- assessment of climate change impacts, valuation of ecosystem services, planning of protected areas and assessment of conservation status at national scales;

- analysis of trends and impacts of land cover/land use changes, monitoring of water quality, prioritisation of areas for conservation, and assessment of environmental risks at local scales.

In Italy, the scientific process for defining and mapping the ecoregions adopted for the present statistic has been defined since the early 2000s.

This approach allows a hierarchical classification of land into increasingly homogeneous units, based on specific combination of the climate, bio-geographical, geomorphological and hydrographic features that determine presence and distribution of species, communities and ecosystems. Since this determinism also influences type and intensity of human activities, these units can be considered as representative of the more general landscape character of a geographic area.

More in detail, Ecoregions of Italy are organised in four nested hierarchical levels (2 Divisions, 7 Provinces, 12 Sections and 33 Subsections). These levels allow the environmental and land use complexity of the Country to be depicted and interpreted under an ecosystem perspective, with different degree of detail and at different scales. As such, ecoregions represent a framework for the design and implementation of environmental-related policies that is complementary to the administrative one.

2. Aim of the ecoregional statistic

The statistics data based on the classification of Italian Municipalities according to Ecoregions takes into account additional information with respect to those already published by ISTAT and regularly updated with respect to the territorial and administrative variations that occur every year.

Until now, municipalities have been mainly classified according to strict geographical parameters, such as altitude, mountain location, surface area, coastal location and degree of urbanisation. The interest of a classification based on additional environmental criteria, including climate, geomorphology and biodiversity, lies in the synergic contribution of these factors to the socio-economic development, growth and evolution in time of each municipality.

In particular, besides the plain determinism on environmental and agricultural features (e.g. environmental risks, meteo-climatic and agro-environmental conditions), the influence of ecological factors on social and economic features (such as well-being, tourism and cultural capital) is worthy of exploration. Therefore, land could be originally interpreted by combining socio-demographic and economic statistics at the municipal level with the characteristic features of reference ecoregions, in terms of climatic, biogeographic, physiographic and hydrographic homogeneity.

3. Methodology

In order to achieve a suitable classification of the Municipalities according to the Italian Ecoregions, a collaboration was established between the Central Department for Territorial and Environmental Statistics (DCAT) of ISTAT and the Interuniversity Research Centre "Biodiversity, Ecosystem Services and Sustainability" (CIRBISES), Department of Environmental Biology, "La Sapienza University" of Rome.

The spatial information concerning ecoregions and municipalities, in their updated versions, was considered. Namely, the adopted maps are:

- the Map of Terrestrial Ecoregions of Italy at the Subsection level, scale 1: 1,000,000;

- the Administrative boundaries of the Italian municipalities (non-generalized format) on January 1st for the years from 2016 to 2023, scale 1: 10,000.

The two maps were overlapped in a GIS environment and, given the difference in spatial resolution, it was possible to automatically assign Municipalities to the different Subsections only in part by:

- "**unique allocation**", for municipalities that fall within a single subsection at least with 95% of their surface (85.5% of municipalities and 82.5% of the national territory);

- "**prevalent allocation**", for municipalities that fall within a single subsection at least with 70% but with less than 95% of their surface (8,0% of municipalities and 9,2% of the national territory).

For assumption, ecoregions represent distinct and continuous territorial units divided only in the presence of geographic islands or external administrative borders. According to this principle, the required spatial contiguity of ecoregions was maintained by revisiting, in some particular cases, the automatically assigned "prevalent allocation" . In these cases, such as along the coastline, the final allocation of Municipality to the subsections has been justified on the basis of the "**continuity of the subsection**".

The allocation of municipalities that intersect different ecoregions without a clear prevalence was assigned on an expert basis by means of more detailed thematic layers. These include the bioclimatic, litho-structural and litho-morphological maps that early informed the definition of ecoregional boundaries (i.e. the Phytoclimatic Map of Italy and following updates, the three- dimensional structural model of Italy, the Land Units Map of Italy). By considering the relative importance of each factor in determining the involved discontinuities, allocation has been justified in terms of " **bioclimatic factors**", "**orographic factors**" and "**litho-morphological factors**" .

In few cases, for Municipalities with even-distributed surfaces (Municipality of Belpasso) or with administrative islands that cross sharp ecoregional discontinuities (Municipalities of Barge, Magliano Alpi, Comano Terme, Saludecio, Fermo and Tricarico), a second allocation was given besides the prevalent one.

4. Preliminary results

Resulting allocation of Municipalities to the ecoregional Subsections for the year 2018 is shown in Figure 1. Main quantitative descriptors concerning the number of municipalities for each ecoregion, the respective cumulative surface and population, in both absolute and relative terms, are indicated in Table1.

Figure 1 – Classification of Municipalities according to the ecoregional Sections for the year 2023

Note: For the classification refer to the table in the Methodological Note
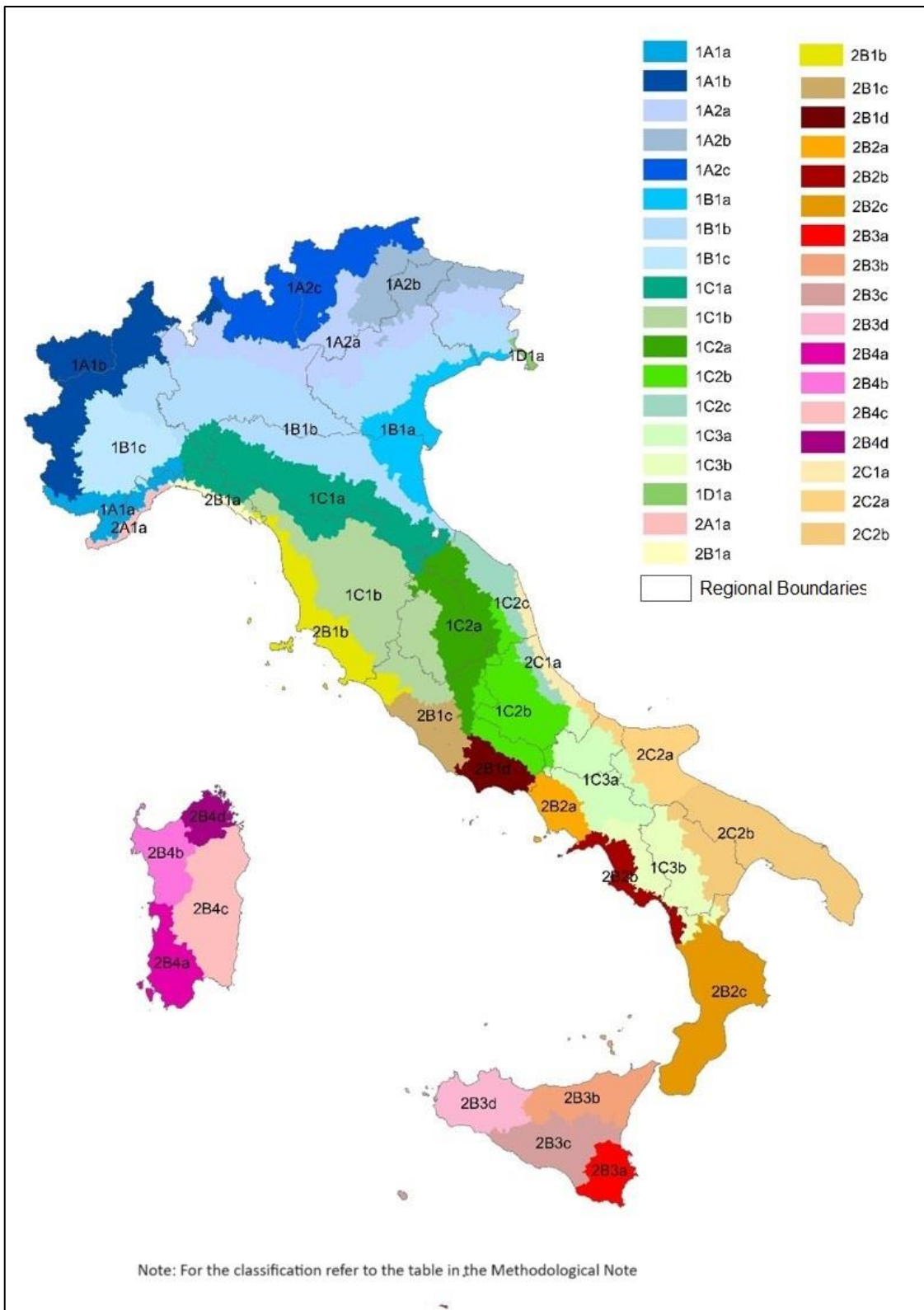
Source: Istat

Table 1 – Number of Municipalities, surface and resident population on January the 1st (2023) for the different ecoregional levels of Italy (absolute values and percentages)

Ecoregion code	Ecoregion name	N° of municipalities	Total area (Km2)	Population 01012016	% Surface	% Population
1	Temperate Division	5.753,0	188.437	33.289.518,0	62,4	56,6
1A	Alpine Province	1.836	53.986	5.513.916	17,9	9,4
1A1	Western Alps Section	640	18.095	1.177.175	6,0	2,0
1A1a	Alpi Marittime Subsection	129	4.131	169.727	1,4	0,3
1A1b	Northwestern Alps Subsection	511	13.964	1.007.448	4,6	1,7
1A2	Central and Eastern Alps Section	1.196	35.891	4.336.741	11,9	7,4
1A2a	Pre-Alps Subsection	788	15.304	3.450.078	5,1	5,9
1A2b	Dolomiti and Carnia Subsection	151	8.340	312.249	2,8	0,5
1A2c	Northeastern Alps Subsection	257	12.247	574.414	4,1	1,0
1B	Po Plain Province	2.126	49.843	19.208.025	16,5	32,6
1B1	Po Plain Section	2.126	49.843	19.208.025	16,5	32,6
1B1a	Lagoon Subsection	102	7.315	1.318.270	2,4	2,2
1B1b	Central Plain Subsection	1.516	33.574	15.211.956	11,1	25,8
1B1c	Western Po Basin Subsection	508	8.954	2.677.799	3,0	4,6
1C	Apennine Province	1.782	84.338	8.334.297	27,9	14,2
1C1	Northern and Northwestern Apennine Section	632	37.954	4.384.763	12,6	7,5
1C1a	Toscana and Emilia-Romagna Apennine Subsection	341	17.337	1.351.143	5,7	2,3
1C1b	Tuscan Basin Subsection	291	20.616	3.033.620	6,8	5,2
1C2	Central Apennine Section	607	26.575	2.545.396	8,8	4,3
1C2a	Umbria and Marche Apennine Subsection	172	10.388	736.242	3,4	1,3
1C2b	Lazio and Abruzzo Apennine Subsection	285	11.262	749.340	3,7	1,3
1C2c	Marche and Abruzzo Sub-Apennine Subsection	150	4.925	1.059.814	1,6	1,8
1C3	Southern Apennine Section	543	19.809	1.404.138	6,6	2,4
1C3a	Campania Apennine Subsection	353	10.213	891.868	3,4	1,5
1C3b	Lucania Apennine Subsection	190	9.596	512.270	3,2	0,9
1D	Italian part of the Illyrian Province	9	270	233.280	0,1	0,4
1D1	Italian part of the Illyrian Province	9	270	233.280	0,1	0,4
1D1a	Italian part of the Illyrian Province	9	270	233.280	0,1	0,4
2	Mediterranean Division	2.151,0	113.926	25.561.199,0	37,7	43,4
2A	Italian part of Ligurian-Provencal Province	69	1.042	425.795	0,3	0,7
2A1	Italian part of Ligurian-Provencal Province	9	1.042	425.795	0,3	0,7
2A1a	Italian part of Ligurian-Provencal Province	9	1.042	425.795	0,3	0,7
2B	Tyrrhenian Province	1.700	86.760	19.936.460	28,7	33,9
2B1	Northern and Central Tyrrhenian Section	259	16.431	6.954.788	5,4	11,8
2B1a	Eastern Liguria Subsection	35	800	830.279	0,3	1,4
2B1b	Maremma Subsection	78	7.356	1.175.000	2,4	2,0
2B1c	Roman Area Subsection	70	4.632	4.217.846	1,5	7,2
2B1d	Southern Lazio Subsection	76	3.643	731.663	1,2	1,2
2B2	Southern Tyrrhenian Section	670	20.091	6.604.628	6,7	11,2
2B2a	Western Campania Subsection	181	3.425	3.864.401	1,1	6,6
2B2b	Cilento Subsection	127	3.380	997.495	1,1	1,7
2B2c	Calabria Subsection	362	13.286	1.742.732	4,4	3,0
2B3	Sicilia Section	391	26.139	4.802.016	8,7	8,2
2B3a	Iblei Subsection	36	3.807	650.495	1,3	1,1
2B3b	Sicilia Mountains Subsection	182	7.320	1.241.985	2,4	2,1
2B3c	Central Sicilia Subsection	80	7.985	1.293.194	2,6	2,2
2B3d	Western Sicilia Subsection	93	7.027	1.616.342	2,3	2,7
2B4	Sardegna Section	380	24.099	1.575.028	8,0	2,7
2B4a	Southwestern Sardegna Subsection	77	5.140	623.172	1,7	1,1
2B4b	Northwestern Sardegna Subsection	89	5.038	355.473	1,7	0,6
2B4c	Southeastern Sardegna Subsection	191	11.173	456.064	3,7	0,8
2B4d	Northeastern Sardegna Subsection	23	2.748	140.319	0,9	0,2
2C	Adriatic Province	382	26.124	5.198.944	8,6	8,8
2C1	Central Adriatic Section	81	2.096	922.130	0,7	1,6
2C1a	Marche and Abruzzo Coastal Subsection	81	2.096	922.130	0,7	1,6
2C2	Southern Adriatic Section	301	24.028	4.276.814	8,0	7,3
2C2a	Gargano Subsection	63	6.975	752.651	2,3	1,3
2C2b	Murge and Salento Subsection	238	17.053	3.524.163	5,6	6,0
	Total	7.901	302.068,3	58.850.717	100,0	100,0

Source: Istat

5. Further Perspectives

At the level of each individual municipality, organized agglomeration, metropolitan city or administrative province, the ecoregional framework enables the effective use of statistical data for sustainable land planning and resource management. In this regard, strategic references include:

- the Urban Agenda of the European Union, with 10 priority themes and cross-cutting issues for the sustainable development of urban areas in environmental, economic, social and cultural terms;

- the European Strategy on Green Infrastructure, aimed at an informed integration of conservation and restoration of nature, natural processes and benefits that human society can derive from them, in land planning and development;

- the National Strategy for Urban Green Space, aimed at the protection of biodiversity and ecosystem services, at the adaptation to and mitigation of climate change and heat island and at the improvement of human well-being and quality of life by means of strategic lines and cross-cutting actions;

- the local Laws on territorial governance and protected areas that, especially at the regional level, explicitly refer to the ecological network planning tool.

On the other hand, the aggregation and synthesis of municipal statistical data at the ecoregional level, for any hierarchical tier of the classification, are able to support:

- the implementation of the European Biodiversity Strategy, articulated in six complementary and synergic targets that focus on the main drivers of biodiversity loss and aim at reducing pressures on nature and ecosystem services;

- the implementation of the National Biodiversity Strategy, aimed at guaranteeing the persistence of fundamental ecosystem services, at addressing current environmental and economic changes, and at optimising synergies between sectoral policies and environmental protection;

- the knowledge, assessment and valorisation of the Natural Capital in compliance with the National Law n. 221/2015 on "Environmental rules for promoting green economy measures and limiting the excessive use of natural resources";

- the implementation of the National Strategy for Sustainable Development, in terms of assessment and monitoring of Sustainable Development Goals indicators as defined at both the global and national level;

- the implementation of mitigation and adaptation measures to climate change promoted by the corresponding National Strategy and by the White Paper on Rural Development Challenges and Opportunities.