The Use of GIS in Landscape Planning. Cartographic Representations between Knowledge and Action

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Abstract

This contribution reflects on the complexities and new challenges that representation faces in the context of landscape planning, after the innovations introduced since 2004 in the Piani paesaggistici with the Codice dei beni culturali e del paesaggio .
Specifically, an analysis is proposed of the different types of representations present in the Piani paesaggistici: the more interpretative ones are linked to the act of knowing, which in the Piani paesaggistici culminates in the identification of Ambiti di paesaggio; the more technical representations, on the other hand, are related to the sphere of action, which in this contribution refers to the practice of landscape protection through the activities of surveying, mapping and digitizing landscape assets.
The transition from analog representation of documents to the digital representation in the Piano paesaggistico, the significance of base cartography, and the interpretation of the landscape undertaken by the Regions, which is translated into the choice of graphic symbols used, are all themes of reflection that serve as a starting point to consider the relationship between representation and the planning/enhancement of the contemporary landscape, in light of the changes and the evolution of GIS techniques.

Keywords: landscape, planning, landscape areas, landscape assets, GIS

Representation and Planning

> "Representing the territory is already a way of taking possession of it.
> This map is not a mere replica, but a construction.
> One first makes a map to know, and then to act"
> [Corboz 1985, p. 25]

In 1985, André Corboz, in his renowned essay *Il territorio come palinsesto* [1985], reflected on the theme of territorial representation. Since ancient times, human beings have expressed the need to appropriate inhabited space through its representation in maps, icons, and ideograms. Even before the act of writing, the traces of rudimentary drawings of elements that characterized the lived environment served as evidence of human presence, expressing an ancestral form of communication and a need to control the territory. When humans draw and simplify the surrounding reality, they effectively take possession of it and recognize the natural environment as a place to inhabit, knowing its characteristics and planning its transformations. Throughout history, the representation of territory has taken on different forms depending on the function it was meant to serve, oscillating between more technical and scientific drawings (for example, medieval nautical cartography, with the *Carta Pisana* from 1275 as a remarkable example) and iconographies with a more philosophical and speculative value (such as the Ebstorf *Mappa Mundi* from the same period).
In more recent times, while representation techniques have significantly evolved and philosophical speculation has been largely set aside, at least in the fields of architecture and urban planning, the metaphorical and interpretative aspect has not been lost. It continues to

coexist with more technical representations. In planning, one might assert that the former (interpretative maps) are tied to knowing, while the latter (technical maps) relate to action.
Many studies from the 'territorialists' school, led by urban planners like Alberto Magnaghi and Roberto Gambino, have focused on the role of representation as a means of knowing the territory. In this context, representation fulfills the task of constructing and communicating territorial knowledge [Lucchesi 2005], constituting the 'knowledge framework' in territorial planning. This framework includes the analytical maps of the plan, where geological, morphological, and hydrographic studies converge and intertwine [Gabellini 1996]. From these interpretative studies of the territory emerge and define territorial figures, or "territorial entities recognized for the specificity of the morpho-typological characteristics that persist in the historical process of stratification of different territorialization cycles. The cartographic representation of these characteristics synthetically interprets their environmental, territorial, and landscape identity" [Regione Puglia 2015].
Representation as action, on the other hand, refers in territorial planning to regulatory and/or prescriptive maps, which are associated with the body of rules. Indeed, the academic debate has often questioned whether these representations, within the plans, can fully accomplish the function of territorial regulation on their own [Lucchesi 2005], calling for the use of new tools. It is well known that in territorial planning, in cases of inconsistency between a drawing and a rule, the rule prevails. This demonstrates how, even today, despite the use of increasingly sophisticated and advanced representation techniques, territorial governance, in its prescriptive aspects, still cannot rely solely on representation, but finds words more reliable than drawings. Thus, drawing remains a primary tool for knowing and interpreting the territory within the realm of knowledge, but it still encounters limitations, in urban planning, within the realm of action.
The set of considerations expressed thus far find their field of investigation in the new generation of *Piani Paesaggistici*, introduced in 2004 by the *Codice dei Beni Culturali*. These plans are structured into descriptive, prescriptive, and strategic parts. The drafting of the plans, in which the actions of planning and landscape protection intersect for the first time, presents new complexities that have been expressed and resolved through the language of representation, both regarding territorial knowledge and its regulation, protection and transformation.

Landscape Plans

In 2004, the Cultural Heritage and Landscape Code (henceforth CBCP), incorporating the principles of the European Landscape Convention (ELC) [Consiglio d'Europa 2000] signed in Florence four years earlier, introduced in Part III the tool of Landscape Plans, through which "the State and the Regions ensure that the entire territory is adequately known, safeguarded, planned, and managed" [Codice dei Beni Culturali e del Paesaggio 2004, art. 135]. While Article 1 of the ELC highlights the importance of identity and cultural aspects for the recognition and definition of landscape, Article 2 affirms a more 'integral' vision of the landscape [Predieri 1969], extending its scope beyond mere 'natural beauties' to encompass the entire territory. This vision is reflected in the CBCP through the requirement to draft *Piani Paesaggistici* that address the knowledge, protection, enhancement, and planning of the entire regional territory.
Already with the law of June 29, 1939, No. 1497 *Norme in materia di protezione delle bellezze naturali, Piani Territoriali Paesaggistici* (PTP) had been introduced, aiming to subject protected areas to specific land-use regulations. Although these plans concerned only certain protected areas due to their 'significant public interest' [Codice dei Beni Culturali e del Paesaggio 2004, art. 136], the PTPs represent the first tools aimed at landscape protection. The PTPs drawn up under law 1497/39 were optional and limited to 'vast localities' (paragraphs 3 and 4, Article 1, now referred to as 'landscape assets'). With the Ministerial Decree of September 21, 1984 [Ministero per i Beni Culturali e Ambientali 1984], later converted into law on September 8, 1985, No. 431, the shift occurred from the 'possibility of drafting a Plan' to the 'obligation' to do so. However, these plans still did not apply to the entire territory.
The innovations of the new generation *Piani Paesaggistici* compared to the previous *Piani Paesistici* are multiple: (i) they concern the entire territory; (ii) they are drafted in cooperation between the State and the Regions; (iii) they incorporate within them the system of landscape assets as defined in Articles 136 and 142 of the Code, uniting in a single instrument the system of protection (under state jurisdiction) with that of landscape planning (under regional

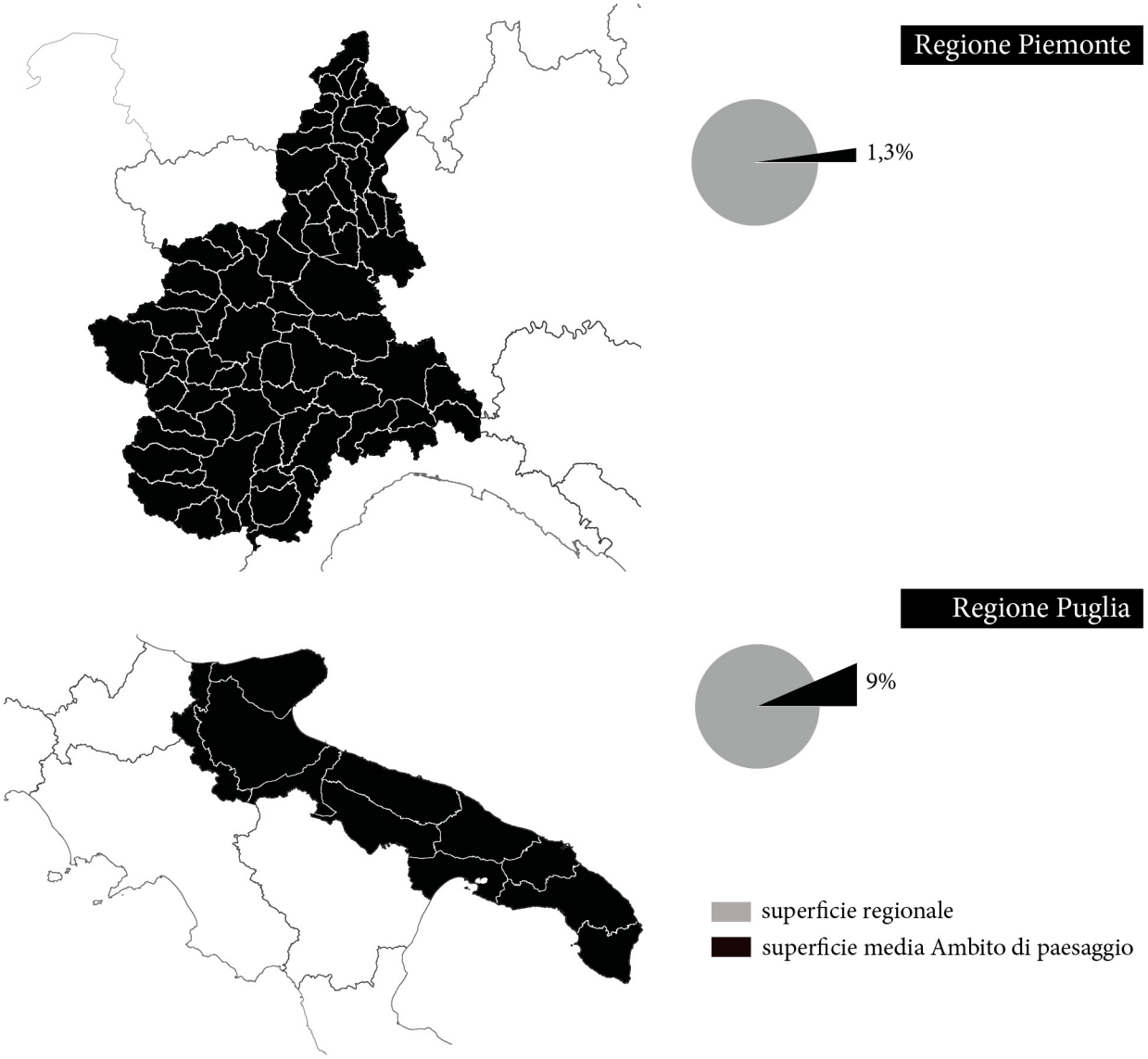

Fig. 1. Comparison between the Landscape Areas defined by the PPR of the Piedmont region (top) and the Landscape Areas defined by the Apulia region (bottom). GIS processing by the author.

Fig. 2. Landscape Areas defined by the Emilia-Romagna region. GIS processing by the author.

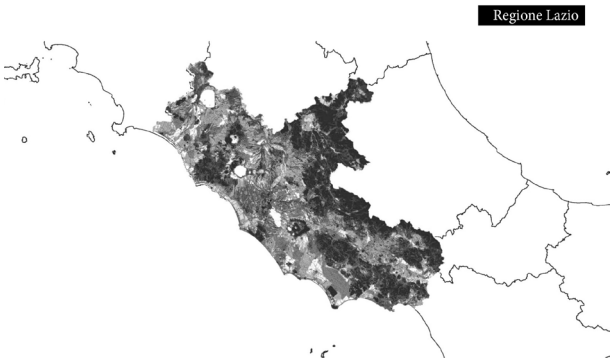

Fig. 3. The 'Landscape Systems' defined by the Lazio region.

jurisdiction), thereby definitively overcoming the dichotomy between planning and protection.
Article 143 of the Code defines the forms and contents of the Landscape Plan, which must include at least the following:
- the survey of the territory subject to planning, through the analysis of its landscape characteristics;
- the survey, delineation, and possible identification of additional "landscape assets" as defined by Article 134 of the Code: this includes both the properties and areas declared of significant public interest under Article 136, as well as areas protected *ope legis* under Article 142;
- the possible identification of further contexts, other than the 'landscape assets' indicated in Article 134, to be subject to specific use and safeguarding measures;
- the identification of risk factors and elements of vulnerability within the landscape;
- the identification of interventions for the recovery and requalification of significantly compromised and degraded areas;
- the identification of necessary measures for the appropriate integration of territorial transformation interventions within the landscape context;
- the identification of landscape areas and their related landscape quality objectives as indicated in Article 135.

For the purposes of this reflection on the role of representation within planning, in its dual function of knowledge and regulation/protection, two aspects will be considered. The first, essentially tied to the interpretation of the landscape, concerns the different ways in which the Regions have defined and represented the *Ambiti di paesaggio* as provided by the CBCP. The second, linked to regulatory and prescriptive aspects, focuses on the complexity of the process of surveying, delineating, and thus digitally representing *Beni Paesaggistici*, prompting a debate on the potential of using GIS for landscape protection.

The interpretation of landscape: Landscape Areas

In outlining the principles underlying landscape planning, the *Codice* states that *Piani Paesaggistici*, with reference to the territory in question, recognize its distinctive aspects and characteristics, as well as its landscape features, and delimit the corresponding areas" [Codice dei Beni Culturali e del Paesaggio 2004, art. 135, paragraph 2]. The definition of a landscape area, as can be seen, is not elaborated upon in the Code, leaving room for free interpretation by the Regions. It could be said that, within Landscape Plans, the identification and cartographic representation of Landscape Areas constitute the culmination of the knowledge and interpretative process of the regional territory. It is no coincidence that, for the execution of this task, regional offices have often relied on academic studies conducted through specific agreements, such as the involvement of the Polytechnic University of Turin in defining *Ambiti di Paesaggio* in the Piedmont *Piano Paesaggistico*.

A landscape area should correspond to a division of the territory that transcends administrative boundaries, providing a new image of the territory where perceptions and feelings of belonging and identity recognition, explicitly mentioned in Article 1 of the ELC, play a dominant role. Although only six *Piani Paesaggistici* have been approved in Italy so far, the work of defining *Ambiti di Paesaggio* is well advanced in most of the Regions.
This allows for an analysis of the different methodologies adopted and the varying interpretations given both to the concept of a landscape area and its cartographic transposition. While each Region has undertaken a unique and specific task for its territory, from the analysis of the cartographic documents, at least three different interpretative approaches can be identified, each corresponding to different representations.
The interpretation of a landscape area that has been adopted by most Regions involves dividing the territory into units with homogeneous characteristics, often grouping municipalities that are part of the same geographic system (a valley, a mountain range) or that share historical traditions or specific cultural traits. In this case, the representation follows the administrative boundaries of the municipalities belonging to the same area. The main difference observed is the scale assigned to the areas by different Regions (fig. 1): from Piedmont, which defines 76 Areas (later grouped into 12 macro-areas) with a smaller average size (334 km^2), to Puglia, which distinguishes only 11 Areas with an average size of 1,776 km^2 [Fondazione Scuola dei beni e delle attività culturali 2024a].
A second group includes those Regions that, in identifying the *Ambiti di Paesaggio*, have placed greater emphasis on the geographical elements and the morphology of the territory. In this case as well, the Region is divided into homogeneous units, but the reading of the landscape prioritizes large geographical systems such as mountains, plains, and river basins. As a result of this approach, the boundaries of the Areas do not correspond to municipal administrative limits.
A clear example of this interpretation is the representation provided by the Emilia-Romagna Region for its Landscape Areas (fig. 2): "The landscape areas present boundaries that are not precisely defined, but rather blurred. The perimeter conceptually becomes not a limit, but a transition zone, an area where the characteristics and objectives of adjacent areas integrate with one another" [Regione Emilia-Romagna 2004].

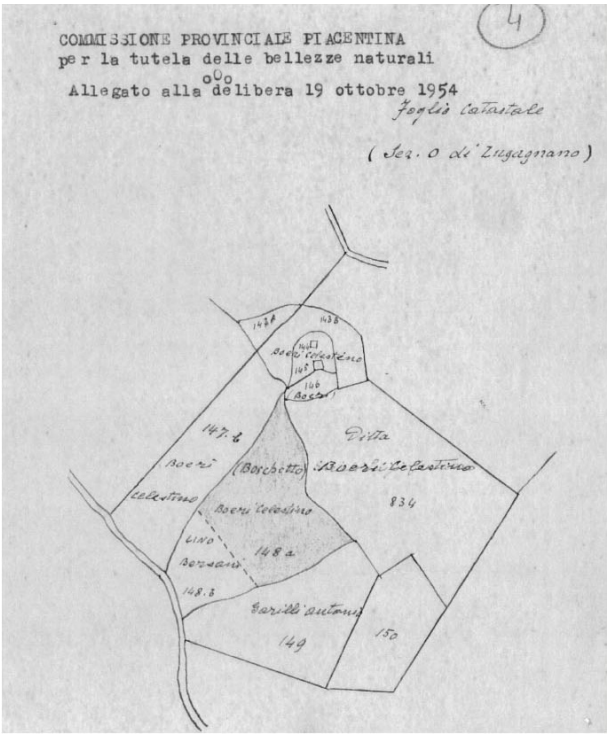

Fig. 4. Some examples of mappings attached to the DMs of Declaration of Notable Public Interest. Grove near the farm 'le Querce' located in the municipality of Lugagnano val d'Arda, 1955.

Finally, there is a third approach that has interpreted the *Ambiti di Paesaggio* as homogeneous 'systems' through which the territory is classified. This is the case of the Lazio Region, (fig. 3) which in its PTPR (Piano Territoriale Paesaggistico Regionale) implements this classification "according to specific typological categories" [Regione Lazio 2021], organized by the relevance and integrity of the landscape values. The resulting representation is entirely different from that of other regions: it involves a detailed breakdown of the landscape, recognizing, within each area, the presence of various systems, namely: (i) the natural landscape system; (ii) the agrarian landscape system; (iii) the settlement landscape system. Each of these corresponds to different levels of value and integrity and,

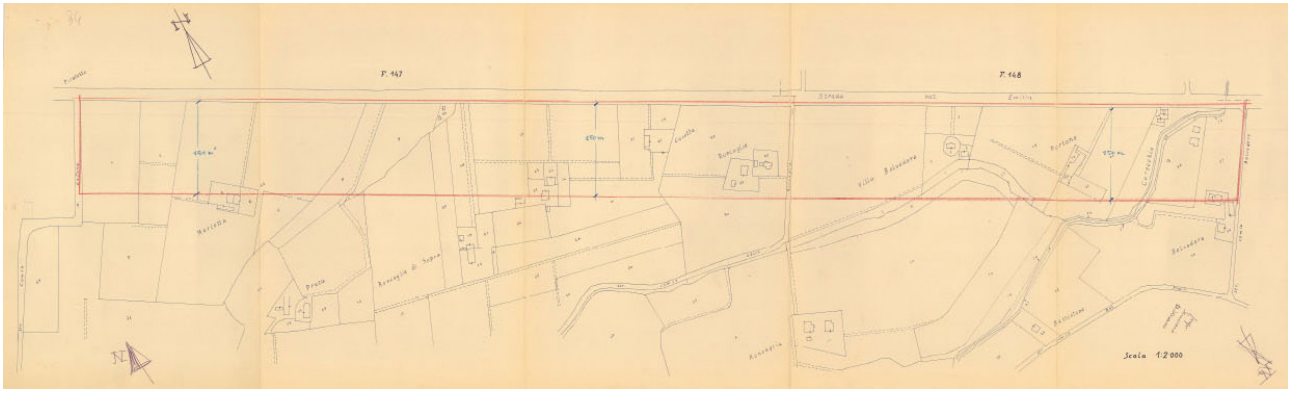

Fig. 5. Some examples of mappings attached to the DMs of Declaration of Notable Public Interest. Area of the Via Emilia between Piratello and Imola, 1965.

consequently, to different actions to be taken for conservation and enhancement.
These three different representations demonstrate how profoundly varied the interpretation of the landscape can be across different territories. For some, the landscape can be distinctly recognized and delineated by composing a set of territorial units, albeit with varying characteristics and extents; for others, the landscape cannot be subjected to precise boundaries but requires transitional areas where each environmental and cultural identity blends into the other; yet for others, the landscape cannot be described through boundaries, even blurred ones, but rather as a set of systems that reflect its inherent complexity.

Landscape regulation: Landscape Assets

While the knowledge of the territory and the interpretation of landscape characteristics may be reflected in highly differentiated representations –reflecting the legislator's decision not to provide specific guidelines for the definition of Landscape Areas– a different approach should be taken when drafting the technical representations that underpin the prescriptive frameworks of the *Piani Paesaggistici*, particularly concerning the regulations for the use of Landscape Assets. In this case, the presence of clear guidelines for representing protected areas becomes essential to ensure the clarity of the regulations.

The initiation of the drafting process for *Piani Paesaggistici* after 2004 brought with it the need to digitize the protection decrees (the declarations of significant public interest under Article 136), which until then were in paper format, and the areas automatically protected by law (under Article 142). The ongoing work of digital representation being carried out by the Regions constitutes a unique opportunity to reconstruct, using GIS technologies, a clear picture of the national protection system, which is currently lacking. The system of *Beni Paesaggistici*, in fact, remains highly fragmented, scattered across a multitude of regional portals, despite efforts by the Ministry to coordinate through information systems like SITAP, which nevertheless lack proper updating and coherence. Thus, with the drafting of the Plans, the Regions, along with the territorial offices of the Ministry of Culture (MiC), find themselves tasked with surveying, delineating, and formally defining the *Beni Paesaggistici*.
This task reveals evident complexities, not only due to the vast number of areas that need to be delineated, but also due to the transition from analog (figs. 4, 5) to digital mapping. This transition represents a primary cause for the delays in landscape planning activities, which have led to only six regions having approved their Landscape Plans to date.
The complexities inherent in the digital representation of *Beni Paesaggistici* can be distinguished between those concerning Article 136 and those concerning Article 142.

In the case of Article 136, "the survey consists of cataloging all acts and declarations of significant public interest, followed by their transposition, through digitalization, of the respective boundaries onto the most recent version of the Regional Technical Map" [Regione Veneto 2017]. Due to the lack of previous digitalization, the work almost always had to begin with the collection of all paper documents of the declarations of significant public interest, some of which date back to the 1920s [2]. It is important to note that the paper documentation consists of the text of the decree as published in the *Gazzetta Ufficiale*, generally accompanied by a hand-drawn map, which is sometimes imprecise or inconsistent with the description provided in the text. Moreover, the changes that have occurred in the territory over time (such as alterations to the road network or new subdivisions) often make it particularly difficult to identify the protected area on an updated cartographic base.
The Emilia-Romagna Region, although it has not yet approved its Landscape Plan, has gradually published the results of the survey of Landscape Assets under Article 136 on its portal, divided by province. The methodology used allows for the identification of all the complexities and various phases of the survey and cartographic representation process. As an example, we can examine the case of the Ministerial Decree (D.M.) of August 1, 1985, 'Declaration of significant public interest for the territory including Corno alle Scale and Monte La Nuda, located in the municipality of Lizzano in Belvedere'. The D.M. text states: "This area […] is delimited as follows: starting from Lake Cavone in a straight line (east) to the summit of La Nuda (altitude 1796.5), then along the ridge to a maximum altitude of 1825 meters (La Nuda peak), continuing northwest to Balzo del Fabuino, and from there north to Sboccata dei Bagnadori, then to an altitude of 1280 along the ridge, descending along the Cannella stream path to the intersection with the Cavone-Lizzano municipal road, following the path until reconnecting with Lake Cavone" [Ministero per i Beni Culturali e Ambientali 1985].
In the survey report for the restriction, the Scientific Technical Committee notes: "The text of the decree and the cartography reveal a significant discrepancy regarding the protected area. The perimeter description refers to Lake Cavone as the starting point for the delimitation of the asset; the cartography excludes Lake Cavone, placing the boundary much further north along a stream not mentioned in the text" [Regione Emilia Romagna, MIBAC 2018].

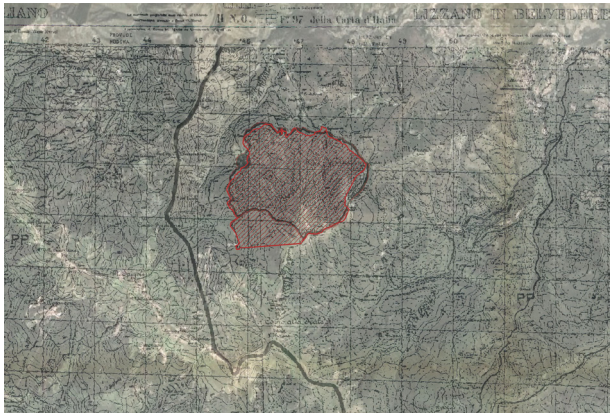

Fig. 6. Overlay between the original cartography bearing the perimeter of the August 1, 1985 DM constraint and the updated vector perimeter (2018). GIS processing by the author.

Thus, the commission's shared decision was to follow the indications of the decree text, including Lake Cavone within the restriction, as it is a key element of the landscape and is cited in the text. Consequently, as highlighted in the images (fig. 6), the digital representation of the asset deviates significantly from the original representation attached to the decree. The vector drawing, on an updated cartographic base, forces the planning process to deal with an unprecedented level of precision, resulting in an outcome derived from the cross-referencing of several elements: the text, the original cartography, and the updated cartographic base.
There are various complexities associated with the representation of assets under Article 142 (fig. 7), which refers to the categories of protected areas originally introduced by Law no. 431 of August 8, 1985, known as the *Legge Galasso* In this case, the protected areas are not identified by specific decrees, and therefore do not have cartography that, even if imprecise, delineates the asset. Article 142 lists, in 11 letters (from A to M), a series of categories of assets for which protection zones and areas are established, applicable across the entire national territory. For these assets, the complexity of representation sometimes lies precisely in identifying the natural element from which to define the protection zone, considering the variability of the element itself, which is not static but dynamic. An example of this is the coastline, which

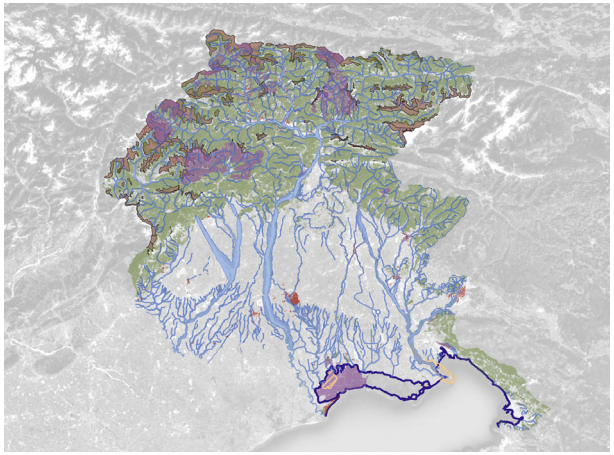

Fig. 7. The set of protected areas under Article 142 CBCP, PPR Friuli - Venezia Giulia. GIS processing by the author.

must be identified to accurately represent the 150-meter protection zone. The same applies to watercourses, which are protected along with their "respective banks or the foot of their embankments, within a 150-meter zone on each side" [Legge n. 431 8 agosto1985, Art. 142, letter C]. To try to provide greater clarity in the definition of these areas, over the years, the Ministry of Culture has issued guidelines through various circulars. In particular, Circular No. 12 of June 23, 2011, published the document 'Analysis of the issues and identification of possible solutions regarding the definition of criteria to be adopted for the survey, delimitation, and representation of landscape assets as established by the *Codice dei beni culturali e del paesaggio* in Article 143, to also be used as support', in which, letter by letter, definitions and survey criteria for assets are provided. However, these documents have not been sufficient to resolve doubts and ambiguities related to all asset categories, some of which still remain too vaguely defined, such as the "areas of archaeological interest" (letter M) [3]. As previously mentioned, it is important to emphasize the dynamic nature of many elements protected under Article 142 (e.g., forests and woods –letter G; or glaciers– letter E), which vary significantly, even due to climate change. This factor prompts a reflection on the effectiveness of using GIS systems for mapping *Beni Paesaggistici*, which, with adequate resources and expertise, could enable the continuous updating of the digital database and the efficient management and monitoring of landscape protection, which has so far been highly fragmented.

Conclusions

The *Piani Paesaggistici*, the first landscape planning and protection tools at the regional scale to be entirely drafted using digital and GIS-based technologies, have posed new challenges and complexities in landscape representation. Between interpretation and technical drawing, the use of GIS has proven indispensable in reconstructing the national framework of the protection system, which can be further implemented once the *Piani Paesaggistici* are approved in all Regions. In conclusion, after discussing the many critical issues encountered in the process of surveying landscape assets, it is important to highlight the potential of GIS as a tool not only for representation (and thus for ensuring the clarity of regulations) but also for managing and exercising landscape protection.
However, the full application of this tool in drafting planning instruments has not yet been fully realized. The transition from analog to digital representation is in itself a significant and essential innovation for territorial governance, but the representation methods used in Landscape Plans are still predominantly traditional, favoring maps with associated legends. GIS, on the other hand, could allow for the implementation of various forms of representation, including three-dimensional ones based on LIDAR surveys, which would provide a deeper understanding of the landscape in its multiple dimensions. As Pittaluga states, "landscape representation can benefit from traditional representations, but it must also take into account the opportunities offered by new image processing and communication tools, according to a process of decomposition and synthesis calibrated on the context as a whole and on the peculiarities of the place" [Pittaluga 1999]. The practice of planning should not be exempt from these considerations.
The work of delineating and representing the areas subject to landscape protection within the Plans, in fact, is the necessary action to enable their subsequent 'formalization', that is, the planning of the protected area, with an approach that seeks to go beyond the merely restrictive approach to landscape protection, focusing instead

on its enhancement. To this end, the type of representation used should move away from the simple 'zoning' of the protected area and offer the possibility of viewing the landscape from a design perspective, illustrating the changes the territory has undergone in the past (such as changes in topography, variations in tree cover, or the shifting coastline) and envisioning future transformations according to the strategic lines of the *Piano*.
The use of GIS allows for the constant updating and improvement of data, an essential element for landscape governance, as it is subject to continuous transformations in both its structural systems and the variation in values and the integrity of its elements due to human intervention.
Finally, it is important to note that sharing GIS data on the OpenData portals of the Regions also allows for the dissemination of landscape knowledge, which can easily become accessible to a wider audience through the creation of WebGIS that recompose the national framework. A clear example of this is the Web portal created by the Fondazione Scuola dei Beni e delle Attività Culturali, built entirely using GIS technology as part of the research project *La Pianificazione e la Tutela del Paesaggio*, aimed precisely at keeping the data on Landscape Planning in Italy together and constantly updated for maximum dissemination. From this perspective, it is important to always bear in mind the role that the European Landscape Convention attributes to citizens, who are the true producers of the landscape, beginning with their perception and awareness of it. Therefore, the dissemination of knowledge, protection tools, and plans and projects concerning the landscape is both a responsibility and an objective for those who work on the landscape.

Notes

[1] The Regions that have approved the Piano Paesaggistico are: Sardinia (PPR, 2006); Puglia (PPTR, 2015); Tuscany (PIT-PPR, 2015); Piedmont (PPR, 2017); Friuli-Venezia Giulia (PPR, 2018); Lazio (PTPR, 2021).

[2] The first protection decrees were published pursuant to Law No. 778 of June 11, 1922, "Legge Croce".

[3] The circular defines areas of archaeological interest as "the territorial areas that include emergent, point-like, or linear archaeological assets, either excavated or still buried, whose character derives from the intrinsic link between the archaeological remains and their landscape context, and therefore from the coexistence of cultural, natural, morphological, and aesthetic values" [Ministero per i Beni e le Attività Culturali 2011].

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