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The integration of the ecological and landscape network in spatial planning Perspective of the strategies of two Alpine regions in France and Italy

Ecological connectivity and network concepts have been integrated as key elements in the nature conservation policies of many countries of the Alpine arc. The idea is to understand ecological dynamics over the entire territory and across administrative borders. In this article, the authors put into perspective policies pursued in two European countries (France and Italy), with a focus on two Alpine regions (Auvergne Rhône-Alpes and Piedmont).



Climate change, to which cities are continually exposed, is one of the major challenges today. Adaptation to climate change implies a renewal of spatial and environmental planning strategies and requires the implementation of multifunctional, flexible

and multi-scale approaches that increase territorial resilience in the medium and long term.

In this context, the requalification of ecological networks seems to be one of the most appropriate strategies for dealing with climate change at different scales. The concept of "ecological network" (Bennett, 1991) and the broader concept of green and blue infrastructure, derived from landscape ecology, were initially identified as fundamental tools to combat the processes of fragmentation of natural areas and reduction of biodiversity. Subsequently they have gained in importance and, in

order to meet the new needs of society, their planning and design have changed and evolved (Giudice, Novarina, Voghera, 2017).

This article looks at the way in which spatial planning deals with green and blue infrastructures at the different territorial scales that are the region (*région*), the metropolitan area (*aire métropolitaine*) and the municipality (*commune*). It focuses more specifically on the processes of identifying the various elements that make up this infrastructure and on the way in which the protection and enhancement guidelines defined in large-scale territorial strategies are translated into local planning documents, which are the only ones with binding regulatory content. The article is based on a perspective of the policies conducted in two European countries (France and Italy), with a focus on two Alpine regions (Rhône-Alpes¹ and Piedmont).

1. We refer to the Rhône-Alpes region (and not to the Auvergne-Rhône-Alpes region) because the regional ecological coherence scheme (*Schéma régional de cohérence écologique*) was drawn up and implemented by the two regions separately, before their merger in 2014.

The institutional and legislative framework

Regional initiatives in Italy

The Italian planning system, still based on Law 1150 of 1942, which establishes the "*piano regolatore generale comunale*" (land use plan), drawn up at municipal level, is facing difficulties in meeting the new challenges of sustainable development and climate change². These challenges imply the need to integrate different territorial issues into local plans in order to pursue a sustainable development strategy: from ecology to environment and landscape. Since 2004, with Italy's ratification of the European Landscape Convention, the landscape has become a central element of spatial planning, particularly at the regional level. More recent is the importance given at the national level to the construction of ecological networks as one of the key objectives of the strategy for sustainable development and biodiversity conservation (2010 and 2017).

Since their establishment in 1970, the Italian regions, unlike the French ones, have been authorised to legislate, particularly in the fields of land development and urbanism. For example, the Piedmont region approved Law 1977/56 "*Tutela ed uso del suolo*" (protection and use of land), which anticipates innovative elements of contemporary planning practice in Italy: it mentions, for example, among its objectives the preservation and enhancement of territories and landscapes and the control of land use. This law, which has been amended several times, establishes the roles to be played by the various tools ("*piano territoriale regionale*" (regional territorial plan), "*piano paesaggistico regionale*" (regional landscape plan), "*piani territoriali di coordinamento*" (territorial coordination plans) and "*piano regolatore generale comunale*" (land use plan)) within the framework of a planning system, which remains hierarchical since the region exercises control over the plans drawn up by the provinces and municipalities.

The Grenelle II law in France: a legal status for the green and blue infrastructure

In France, the "*loi portant Engagement national pour l'environnement*" (the law on the National Commitment for the Environment) (12 July 2010), commonly referred to as the "Grenelle II Law", introduces the notion of the green and blue infrastructure into the "*Code de l'environnement*" (Environmental Code). Article L371-1 of this code reminds us that this infrastructure aims to "halt the loss of biodiversity by participating in the preservation, management and restoration of the environments necessary for ecological connectivity". By taking into account human activities, particularly agricultural ones, these infrastructures must both facilitate the genetic exchanges necessary for the survival of fauna and flora and improve the quality and diversity of landscapes. The green infrastructure includes areas (protected or not) important for the preservation of biodiversity and ecological corridors. The blue one is made up of watercourses, canals and wetlands, as well as the vegetated areas bordering them (riparian forests).

The Grenelle II law establishes two tools for the protection and requalification of the green and blue infrastructures:

- the "*Orientations nationales*" or national guidelines for the preservation and restoration of green and blue infrastructures, which are presented as a methodological tool to identify the different elements that make up this infrastructure;

- the "*Schéma régional de cohérence écologique*" or regional scheme for ecological coherence, drawn up jointly by the Region and the State, which should make it possible to identify and map the elements making up the green and blue infrastructure at regional level and to set up a requalification strategy (which should give priority to drawing up contracts with the various local authorities concerned).

Spatial and urban planning documents, drawn up under the responsibility of public establishments for cooperation between local authorities or municipalities (notably the "*Schéma de cohérence territoriale*" and "*Plan local d'urbanisme*" or territorial coherence plan and local urban development plan, respectively), must take into account the guidelines of the "*Schéma régional de cohérence écologique*" (regional ecological coherence scheme). The Grenelle II Law therefore introduces for the first time into French legislation and regulations the instruments allowing ecological and landscape networks to be taken into account by spatial planning.

The "*Orientations nationales*" (national guidelines) were adopted by decree on 20 January 2014; their content had been prepared by a committee comprising local elected representatives, members of the administration of the Ministry of Ecology and Sustainable Development, professional and association representatives as well as scientific experts. Based on the observation that nature protection policies, which preserve specific areas and target species, have not stopped the fragmentation of natural habitats (which is after all one of the main causes of biodiversity erosion), these guidelines put forward a new concept of nature protection: ecological networks. The concept of green and blue infrastructures, which is akin to it, makes explicit reference to landscape ecology and is presented as a network of biodiversity reservoirs, ecological corridors and watercourses. The more or less fragmented nature of the ecological corridors should make it possible to judge the need for restoration actions.

Ecological network planning and its applications

The ecological network and its integration in Piedmontese landscape planning

In Piedmont, the regional ecological network was established in 2009 by regional law no. 19 "Testo Unico sulla tutela delle aree naturali e della biodiversità" (consolidated text on the protection of natural areas and biodiversity). Article 2 of the law defines the regional ecological network as a network composed of different areas: the "System of Protected Areas in Piedmont", "Special Areas of Conservation" (SAC), "Sites of Community Importance" (SCIs) and "Special Protection Areas" (SPA), part of the Natura 2000 network, natural safeguard areas and ecological corridors.

2. The territorial levels of planning in Italy are the regions (regioni), provinces (province) or metropolitan cities (città metropolitane) and municipalities (municipi).

▶ The "*piano paesaggistico regionale*" (PPR) or regional landscape plan of Piedmont, approved in 2017, proposes a network of landscape and ecological connections that should become the support for cultural and recreational activities (figure 1). This plan considers the ecological network as one of the strategic projects to be developed within the framework of sectoral policies and projects. Emphasis is placed not only on ecological connections but also on landscape enhancement, with the aim of creating a multi-purpose and multi-functional system that combines the functions of preserving biodiversity (performed by the different elements of the ecological networks like nodes, ecological connections and restoration areas) and historical and cultural functions. Deriving from Regional Law No. 19, a deliberation of the regional government of 2015³ approved the methodology for identifying the elements of the regional ecological network. The proposed methodology is defined by ARPA⁴ and is subsequently taken up by some provincial experimentations (e.g. the ecological network of the province of Novara). The ecological models developed allow assessing - on the basis of scientific criteria - the presence of areas of ecological value and other sites with a possible function as ecological corridor, thus providing the necessary conditions for the creation of a dynamic system.

Following the approval of the second "*piano territoriale di coordinamento provinciale*" or Provincial Coordination Plan (PTC2) in 2011, the province of Turin (which in 2015 became "*Città Metropolitana*" or "Metropolitan City"), developed and adopted in 2014 a different methodology for the construction of ecological networks in collaboration with ENEA⁵; this collaboration led to the preparation of a set of reference guidelines. The final document, "*Linee guida per il sistema del verde*" (LGSV, "guidelines for the green system"), intends to pursue the objectives of limiting land take, landscape and ecosystem fragmentation and impoverishment while promoting the rational use of natural resources. These guidelines, provided for by Article 35 c. 4 of the PTC2 implementation standards and adopted by Provincial Decree No. 550-23408/2014, are designed to provide municipal administrations and urban planning and environmental professionals with technical and/or procedural guidelines to implement the objectives of the PTCP. To meet these objectives, these guidelines are divided into categories: "*Linee Guida per la Rete Ecologica*" (guidelines for the ecological network), "*Linee Guida per le Mitigazioni e Compensazioni*" (guidelines for mitigation and compensation) and "*Linee Guida per le Aree Periurbane*" (guidelines for peri-urban areas). The first, the guidelines for the ecological network, are the subject of our reflection.

The approach used by the Metropolitan City of Turin for the construction of ecological networks is of a bio-ecological type. It has been gradually consolidated and is based on conservation models developed in American and English experimentations, which combine knowledge of conservation biology with that of ecosystem and landscape ecology (Bennett and Wit, 2001). Here, the main objective of the construction of the ecological network is the conservation of biodiversity, with particular attention to the most valuable natural areas and threatened species.

Such an approach views the network primarily as a system of interconnected habitats⁶. Subsequently, it can support landscape and recreational functions by creating links between landscape units such as public parks and gardens and nature reserves and by developing relaxation and leisure functions. The methodology, starting from a mapping of land use, seeks to evaluate on the one hand the ecological functionality of the different spaces and on the other hand the critical situations from an environmental point of view. The ecological and

1 The network of landscape and ecological connections in Piedmont (source: RLP, 2017).



3. Deliberation of the Regional Government of 31 July 2015, N° 52-1979, regional law of 29 June 2009, N° 19 "Consolidated text on the protection of natural areas and biodiversity". Approval of the technical-scientific reference methodology for the identification of the elements of the regional ecological network and its implementation. Official Bulletin n. 36.

4. Acronym for "*agenzia regionale per la protezione dell'ambiente*" or regional environmental protection agency.

5. Acronym for "*agenzia nazionale per le nuove tecnologie, l'energia e lo sviluppo economico sostenibile*" or (Italian) national agency for new technologies, energy and sustainable economic development.

6. Habitats, in this context, are considered as communities characterising an environment, with their own ecological characteristics of complementarity and integration of their components.

environmental criteria used are the degree of naturalness, relevance for preservation, fragility, extorsion and irreversibility (Voghera and Giudice, 2019). The combination of the first two criteria (naturalness and relevance for preservation) makes it possible to assess the ecological functionality (high, moderate, residual and null) of the different areas.

This methodology, developed at the metropolitan level, has been tested at the local level in some municipalities of the Turin metropolitan area: Bruino, Ivrea-Bollengo and Chieri. These three experimentations were built on the basis of an analytical process of identification of the supra-municipal ecological system and, in the cases of Bruino and Ivrea-Bollengo, also through a participatory process using concertation tables. The experimentation of the municipality of Chieri has also taken into account its important landscape and historical heritage, which has been connected and integrated into the concept of the local ecological network (Figure 2). This experimentation represents an important moment in the overall territorial and landscape project, thus envisaging the need for a complete revision of the forecasts of the land use plan (piano regolatore generale comunale), in order to take into account the transformation of disused or under-used areas.

A strategy for the restoration of the green and blue infrastructure: from regional guidelines to local operational actions

The "Schéma régional de cohérence écologique" (SRCE, regional ecological coherence scheme), approved by the regional council and then by the prefect in 2014, is not the first initiative of the Rhône-Alpes Region in terms of protecting ecological networks. It emerges as the culmination of a series of initiatives taken outside any regulatory framework by this same region. In 2007, the region launched the study of an atlas aimed at mapping all the ecological networks of Rhône-Alpes (called "RERA" atlas) and on this occasion laid the foundations for identifying the various elements that make up what would later be called the green and blue infrastructure. To this end, it drew on the initiatives taken by the department of Isère, by local authorities and their technical partners (in particular the Planning Agencies of the three agglomerations of Grenoble, Lyon and Saint-Etienne) during the studies for the "Schémas de cohérence territoriale", the territorial coherence plans. The Rhône-Alpes region is even presented as a "precursor of the Grenelle dynamics" (*Préfet de Région, Région Rhône-Alpes, 2014-I, pg. 6*).

This method of building the green and blue infrastructure is taken up again during the study for the regional ecological coherence scheme ("Schéma régional de cohérence écologique"), taking into account the constraints set by the Grenelle II Law, which makes it compulsory to include protected territories (under French and European legislation) in biodiversity reservoirs. This method, which is not based on "modelling on the basis of species input", favours an "eco-landscape" approach: the regional ecological coherence scheme has a role in ensuring the consistency of the various protection policies and for this reason it integrates existing protection areas (approximately 25% of the regional territory) that are "recognised as relevant by the scientific community and local stakehol-

2 Map of ecological connections in the municipality of Chieri (source: RLP Chieri).



ders" (*Préfet de la Région, Région Rhône-Alpes, 2014-II, pg. 139*). With regard to ecological corridors, here again the method is intended to be pragmatic and is therefore based on a synthesis of the work and studies carried out during local planning processes. In this way, the SRCE identifies two types of corridors: spindle-shaped ones that allow good permeability and linear corridors, which are more fragile and must be the subject of restoration actions. The SRCE is therefore based on the development of a shared diagnosis that has benefited from the involvement of stakeholders (local elected officials, representatives of the economic world, particularly the agricultural sector, nature protection associations, scientific experts) represented in the regional committee that has monitored its development.

On the basis of such a diagnosis, strategic guidelines have been defined, among which:

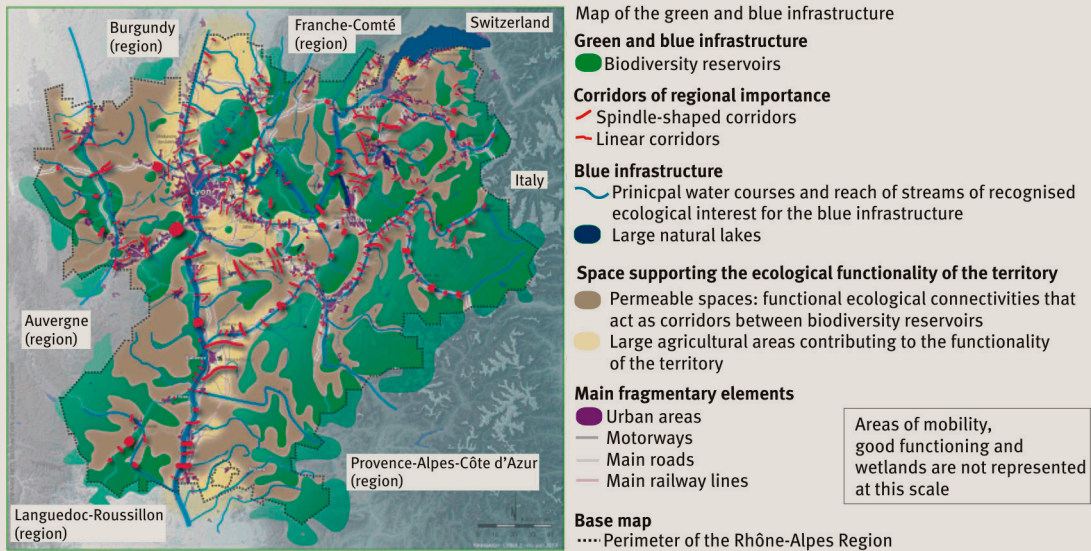
- the obligation for municipalities and intercommunities to preserve in their urban development plans the elements identified at regional level as constituting the green and blue infrastructure;
- the reconstruction of the ecological connectivities damaged during the building of linear transport infrastructure (like motorways and railway lines);
- the preservation of agricultural and forest areas (which constitute the matrix within which the green and blue infrastructure is organised) and the reinforcement of their permeability;

- support for the emergence of local projects to preserve and restore the green and blue infrastructure (financed by the region within the context of the “*Contrats de corridors biologiques*” (biological corridor contracts) and subsequently the “*Contrats verts et bleus*” (literally “green and blue contracts”).

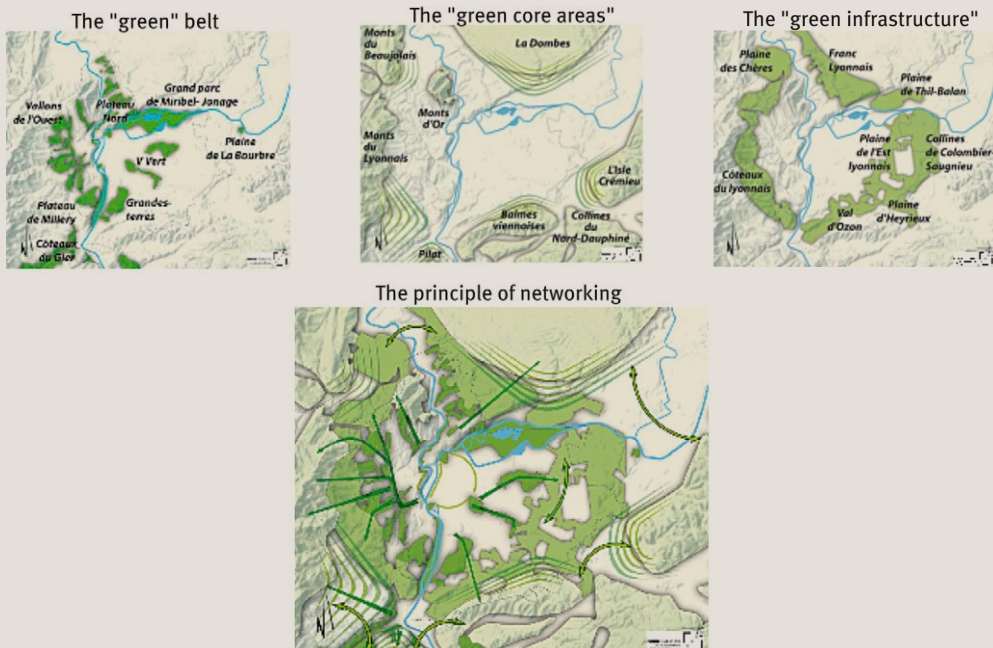
The Rhône-Alpes Region has therefore chosen to implement its SRCE on the basis of both regulatory constraints (the need to include regional guidelines in local urban development plans) and support for local initiatives within the framework of contractual procedures (Figure 3). The implementation of this scheme therefore depends to a large extent on the willingness and ability of local actors to translate regional guidelines into prescriptions and action programmes.

The elaboration of territorial coherence plans (*Schémas de cohérence territoriale*) provides a means for this implementation. The SCoT for the agglomeration of Lyon, for example, was approved in 2010 and, in a way, prefigures the choices of the regional ecological coherence scheme (*Schéma régional de cohérence écologique*). The green and blue infrastructure is part of an overall strategy for sustainable land use planning based on a polycentric organisation of the agglomeration. The various elements making up these infrastructures make the limits to urban expansion tangible (green belt), they accompany the polycentric organisation by formalising breaks (green infrastructure) and provide amenities and ecosystem services in the densest part of the agglomeration, which contribute to improving the quality of life (core areas).

3 Regional map of the green and blue infrastructure (source: Rhône-Alpes SRCE, 2014).



4 The principle of networking nature spaces (source: SCoT of Lyon, land use and sustainable development project, 2010).

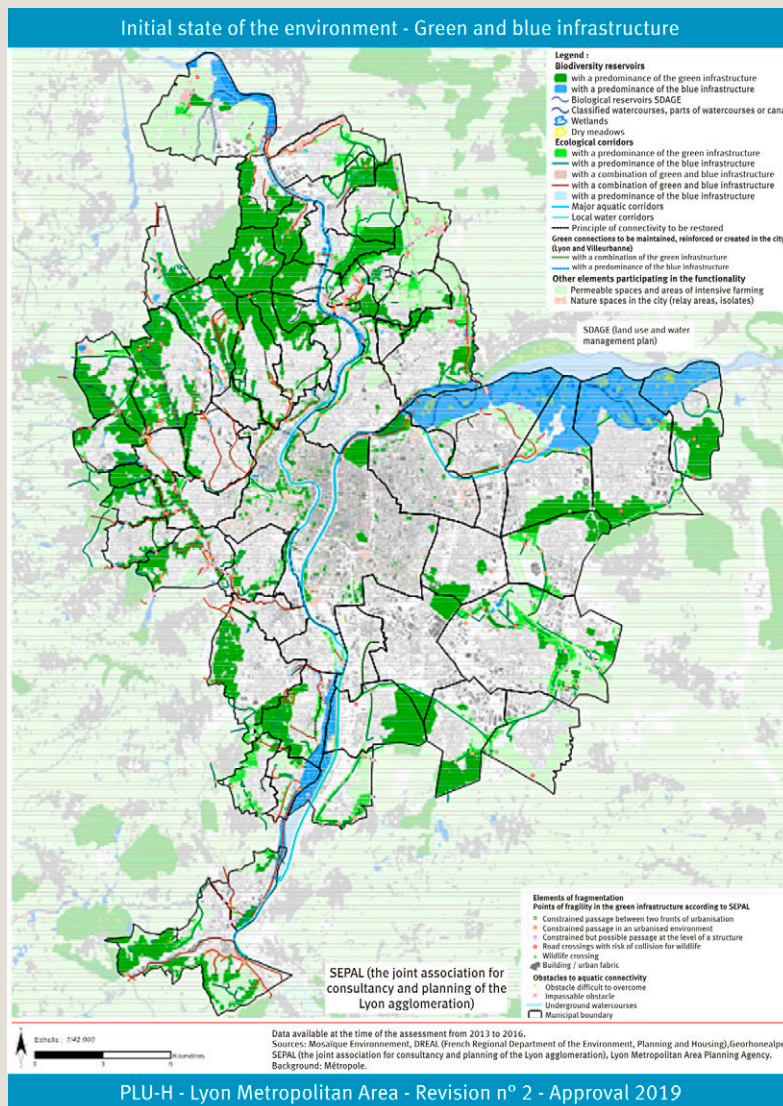


In the same way as the public transport network, the green infrastructure ("armature verte") and the river network are seen as structuring elements in the architecture of the organisation of the metropolitan territory (Figure 4) and the "Document d'orientations et d'objectifs" (the guidelines and objectives document) establishes the principle that "Plans locaux d'urbanisme" (the local urban development plans) and operational projects must contribute to the preservation of cores of biodiversity and the improvement of the quality of ecological corridors. The "Plan local d'urbanisme et d'habitat" (PLU-H, the Local Urban Planning and Housing Plan) approved in 2019 by the Metropolis of Lyon takes up the guidelines of the territorial coherence plan (*Schéma de cohérence territoriale*) (Figure 5). It recalls that the first initiatives taken by the local authorities of the Lyon agglomeration in favour of the restoration of the green and blue infrastructure date back to the early 1990s (*Charte de l'éco-*

logie urbaine, Schéma directeur Lyon 2010 or Urban Ecology Charter, Lyon 2010 territorial scheme). The PLU-H identifies more precisely the elements that make up this infrastructure, particularly in the central part of the agglomeration (Lyon-Villeurbanne). It emphasises the multifunctionality of this infrastructure: contribution to the preservation of biodiversity, food production, leisure activities, support for social interaction, relaxation spaces, air and water filtration, pollutant fixation, regulation of water flow. Emphasis is therefore placed on the diversity of ecosystem services provided by the green and blue infrastructure.

The PLU-H uses a wide range of regulatory provisions to preserve biodiversity reservoirs and ecological corridors: classification as an agricultural or natural area, establishment of woodland or green spaces to be valorised in urban areas. Finally, the PLU-H insists on the need to set up a project approach: "just as the city is the object

5 The green and blue infrastructure of the local urban development and housing plan (Plan local d'urbanisme et d'habitat) of the Metropolis of Lyon (source: Lyon Metropolis PLU-H, 2019).



of urban projects led by the local authority, the spaces of the green and blue infrastructure require the implementation of projects that are specific to them" (*Grand Lyon La Métropole, Urba Lyon, 2019, pg. 71*). Among the many projects implemented at the initiative of the Lyon Metropolitan Area, mention can be made of the "Projets Nature" (Nature Projects), which aim to encourage opening natural spaces to the public, the "Protection des espaces agricoles et naturels périurbains" or PENAP (protection of peri-urban agricultural and natural areas), which seeks to reconcile the development of farms with the preservation of the environment, the management of river banks and the "Anneau Bleue" (Blue Ring), which attempt to restore the naturalness of wetlands (Novarina and Seigneuret, 2016).

Some lessons

The approach of ecological networks based on landscape ecology entered the professional world of planning in Italy as early as the 1990s, and the establishment of a "sistema del verde" (green system)⁷ was first outlined by the planner Bernardo Secchi in the Bergamo land use plan (*piano regolatore generale comunale*) (1995), before becoming a shared value for Italian urban planners. In France, initiatives existed at that time, but they were slow to unite. We can therefore speak in this case of a real 'Grenelle effect' (Clergeau, Blanc, 2013, p. 15): the introduction by the Grenelle II Law of the green and blue infrastructure in the "Code de l'urbanisme" and the "Code de l'environnement" (building and urban land use code and environmental code), the preparation of national guidelines and the study by the regions of regional ecological coherence schemes have led to a multiplication of exchanges between naturalists, urban planning professionals and associations for the protection of the flora and fauna leading to the emergence of a shared culture, the effects of which can be measured today when analysing the content of many territorial coherence plans and local urban development plans.

The "French" approach is first and foremost pragmatic: a certain mistrust of modelling explains the desire, during studies prior to the ecological coherence schemes (*Schémas de cohérence écologique*), to build on existing work, whether scientific or based on inventories carried out by associations, and to compile a synthesis of this work. Although this approach is based on the development of maps (using geographic information systems), it refuses to see these maps as a regulatory tool. For example, the Rhône-Alpes region's ecological coherence scheme entrusts the territorial coherence and the local urban development plans (*Schémas de cohérence territoriale*

and *Plans locaux d'urbanisme*) with the task of adjusting the boundaries of biodiversity reservoirs and ecological corridors or even of re-examining their architecture. The approach is intended to be iterative and the emphasis is placed on the interactions between regional and local planning. As soon as the Grenelle II Law was passed, the multifunctional nature of the green and blue infrastructure was emphasised, to such an extent that pedestrian and cycle paths within the ecological corridors are multiplying, without any precise measurement of their impact on biodiversity. The restoration of the green and blue infrastructure must indeed become an opportunity to build a new type of urban project that does not focus on built spaces but on empty spaces and which must contribute to economic development.

In Italy the increasing involvement of research departments of universities and polytechnics has led to the use of more rigorous methods⁸, which are constantly being improved. Analyses and studies most often lead to a call for increased regulatory protection, which in the case of the Piedmont region is based on the regional landscape plan (*piano paesaggistico regionale*). The territorial coordination plans (*piani territoriali di coordinamento*), the equivalent of the territorial coherence schemes (*Schémas de cohérence territoriale*), are the framework for experimentation aimed at taking better account of regional guidelines in local planning, which - as in France - is the only one with a binding character. The approach is resolutely naturalistic and tends to favour an ecological approach to landscapes. While in Italy the emphasis is mainly on regulatory constraints, in France many initiatives are attempting to make the green and blue infrastructure the subject of operational project approaches. ■

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7. The term "sistema del verde" (green system) was used in the 1990s by both ecologists and Italian urban planners to define the complex of reservoirs of naturalness and ecological corridors. It reflects the influence of landscape ecology on the practice of spatial planning.

8. Ecological networks within the Metropolitan City of Turin have been identified as part of a research programme led by Angioletta Voghera.



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