



Landscape through ecology

From theory to a territorial reading

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Dedicated to my (two) families,
and Julien.

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Introduction

Landscape is a concept, an idea, and a definition that transcends fields of knowledge and action. Dictionaries have defined this word as (1) everything you can see when you look across a large area of land, especially in the country, (2) a painting of a view of the countryside, and (3) the characteristic features of an area of activity (Oxford University Press, 2024). The landscape has been a constant element studied through multiple lenses but has always been composed of two contrary entities: nature and culture.

For instance, in the 1960s ecology centred its efforts on the analysis of the most homogeneous animal and plant systems where man was considered nothing but a disruptive element of natural functions. It was, therefore, unthinkable to study the ecology of urban environments (Clergeau, 2007). Ever since there has been a slow transition towards an inclusive vision of gradients, it is through ecology that the in-between, undefined and intermediate elements began to be observed and analysed as a typology forming part of a greater ecological dynamic. Since the 1980s, the landscape has been seen as a system of interacting elements beyond administrative and plot borders. The methods for reading and studying it have evolved and continue to do so.

Even though as architects, urbanists and land planners, we undergo a necessary paradigm shift regarding the importance of environmental issues, there is still a gap between our field and expertise derived from ecology theories, particularly landscape ecology. Given the nature of its concepts, it can be considered one valuable instrument for creating means of communication and collaboration to work alongside ecologists and other experts in environmental matters to find cross-disciplinary solutions to land-use challenges. For this, the biggest and most important conundrum is understanding the landscape mosaic,

its intricacies and potential. This is by no means an attempt to regain the all-almighty position the architect once had, but rather humbly approach a site with caution and care, acknowledging its environmental and social needs. Admitting how crucial ecology is, we must learn from it and build bridges between the two disciplines. Richard T.T. Forman, often regarded as the “father” of landscape ecology, suggests that land-use planners and architects can significantly contribute to the ecological health of the environment by incorporating a landscape ecology approach into their projects (Dramstad et al., 1996). To understand the landscape we must learn how to observe the patterns and behaviours of the biodiversity’s structure and functioning. It is only then that conscious, responsible and adapted projects may arise, capable of responding to today’s changing panorama.

This work has the main objective of depicting the basic notions mastered by ecology-related disciplines and theories used to interpret the landscape. By creating a general understanding, a deeper reading of the territory will be possible. Then, a proposal for the operationalisation of these concepts will be presented. Nyon was selected to experiment with the theoretical and cartographic exercise because of its intriguing location, ecological values and active participation in environmental conservation and promotion projects. Thus, Nyon’s landscape will be the testing ground for developing profound readings capable of integrating biodiversity in future projects or urban planning.

The first part of the research titled *In situ* formulates a brief portrait of the testing ground: Nyon. Varying between the communal, regional and agroecological regional scales, the chapter describes the natural landscape, the ongoing land-planning strategies, and the biodiversity and ecological action plans developed in the past and today. This is to create a general comprehension of the area of study that is portrayed through various lenses in the next section.

The second part named *Landscape representations* presents a non-exhaustive yet assertive definition of the most important concepts of three major ecology-based theories: Landscape ecology, developed by Richard T.T. Forman and Michel Godron; *Écologie du paysage*, proposed by Jacques Baudry and François Burel; and finally a compilation of landscape and ecology in urbanism theories, which will include *La ville poreuse* by Paola Viganò and Bernardo Secchi and *Le tiers paysage* by Gilles Clément. Throughout the chapter, the theory will be represented through a compendium of photography taken on-site and cartographic representations of the explained notions. This chapter aims to incite an introductory absorption of these theories.

The third section called *Lessons learned and landscape re-interpretations* shares the executed methodology during the formulation of this work, as the learnings and particular details obtained from the site visits. Lastly, it will outline the knowledge obtained from the exercise, listing a series of possible and specialised operations to apply during the project or urban design related to the learned landscape ecology concepts. Hence, the first set of conclusions that will be followed by the final general conclusion.

This work is to be considered as a contributor to the creation of ecologically mindful and respectful projects across various scales.

In situ



Total surface	6.8 km ² / 680 Ha
Forested surface	583 Ha
No. of habitants	22,976
Altitude	372-478 m
Canton	Vaud ¹

Located between Geneva and Lausanne, the Nyon commune and region is ecologically and historically rich. Nyon was selected as the area of study due to its ecological and land-planning values, as well as its interest and active action in terms of nature and environment in these past years. This next chapter will paint an introduction to its landscape and current urban development and biodiversity initiatives to better understand its context for the late chapters and cartography.

Nyon and its (natural) landscape

Known as a landscape of Roman remnants, the commune of Nyon stands as evidence of architectural heritage. Beyond its historical value, it is located in a strategic region between two major nature reserves, the Lake Geneva (or Léman) and the Jura. Notably, the significant watercourses of the area weave a connection between these two reserves, further enhancing their natural significance.

In the past, Nyon's built environment occupied only the historical borough and just a few houses scattered across the landscape between cultivated lands. Agricultural fields were the most predominant usage, sharing the space with open lands and meadows. Watercourses, such as the Boiron and the Asse, were open-air, while the Cossy extended until the northwest part of the Le Truel neighbourhood. Nyon hosted important ecological resources and singularities such as lakeshore or wetland vegetation, meadows of mountain acidophilic flora, and sandy fields of messicolous weeds (Delarze, 2012) that disappeared after the 18th century. Yet, important landscape elements have prevailed. The Bois-Bougy forest, the previously mentioned watercourses, and a few dams and meadows of rare flora.

Besides the latter ecological resources, Nyon is characterised today by five main habitat subnetworks: the open waters, as of waterways and their shorelines; the wetlands, consisting of marshes, ditches, and bodies of stagnating waters; the forests or woodlands, regarding

¹ Information of the commune of Nyon retrieved from the official website.



Cantonal ecological network (REC-VD) in Nyon region

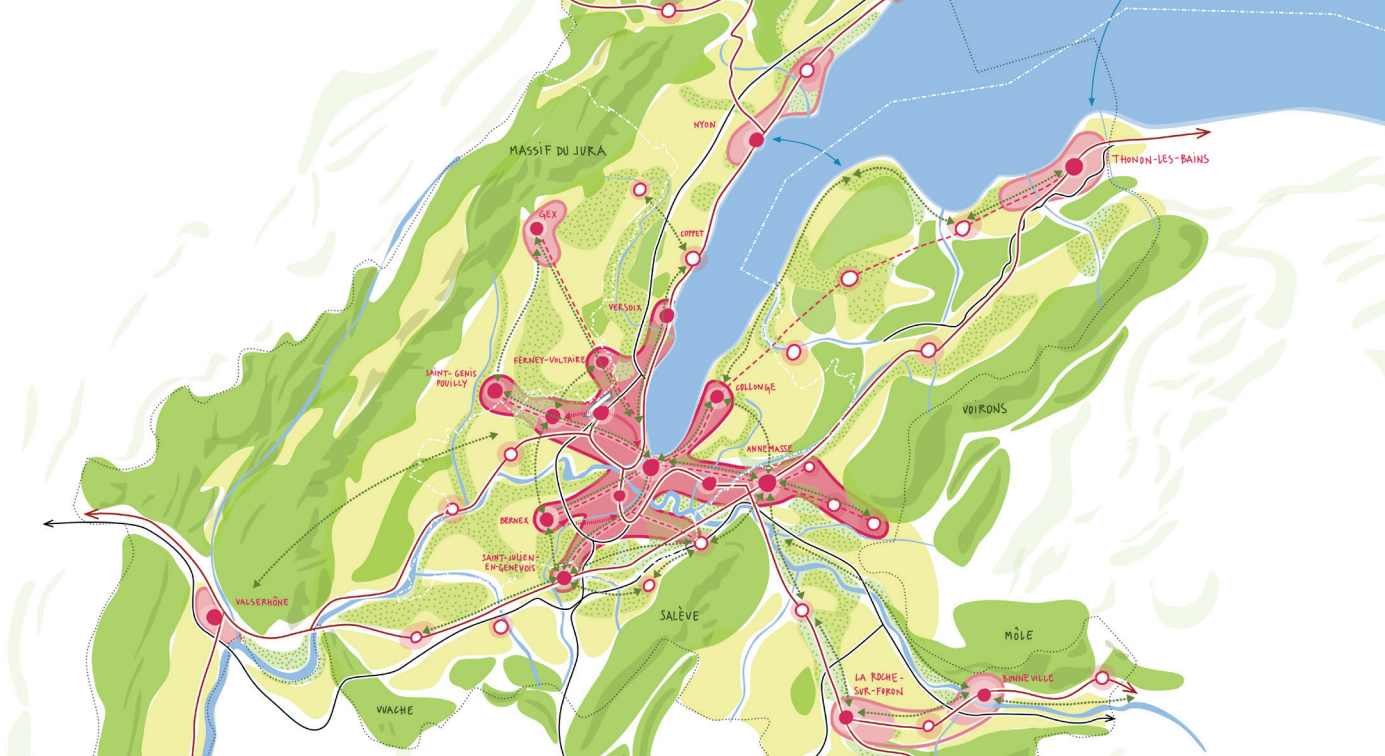
- | | | |
|---|--|--|
|  Waterbodies |  Amphibian corridor |  Missing corridor |
|  Watercourses |  Terrestrial corridor |  Nodal zones or territories of prioritarian ecological interest |

copses and wooded strips; the drylands, of rocky and dry areas; the agricultural lands, including crops, grasslands, fallow lands and hedgerows; and the developed lands, which cover buildings, roads and paths, covered areas, ruins, among others. Each subnetwork presents several biotopes and species that fulfil their biological cycles in these habitats (Delarze, 2012). The latest survey of the existing environments was executed in 2011 guided by the typologies used in the *Guide des milieux naturels de Suisse* of 2008. Nowadays, a more recent study is being done by the Environment Department of Nyon, but since this information has not been completed, the *Inventaire des valeurs naturelles de la commune de Nyon* (2012) by Raymond Delarze will be consulted.

Nyon forms part of a Regional Ecological Network (REC-VD) also brought forward by the Lemanic Ecological Network (REL) of 2005 and the International Commission of Waters of the Léman (CIPEL). Regionally, the main ecological corridor is found in the Promenthouse waterline, as it connects the Jura with the Léman, and the Boiron stream is an important aquatic corridor. In summary, Nyon has five important nodal zones of mostly amphibian and terrestrial species spread on the landscape in agricultural, wetland, open water, woodland or forest, and dryland habitats.

The city is surrounded by important natural elements that carry biodiversity into urban zones. Yet, due to façade renovation and maintenance works, species colonies, like those of birds, have disappeared. Other issues inside the city also come in the form of barriers in the Asse and Boiron streams. These thresholds compromise fish migration and reproduction spaces. Road system intersections and fencing are also significant hurdles for terrestrial wildlife movements. Nevertheless, various urban spaces show potential and ecological richness, especially in unconstructed unused plots or worksites. Sadly, most privatised gardens and green areas hold poor urban biodiversity and sometimes welcome invasive problematic species. The dominant farmlands are equally impoverished in terms of ecological diversity, except for the remaining scattered meadows. The drylands of Nyon are isolated, as the linking elements rely on wildlands and worksites causing them to be unreliable.

Nyon's landscape is rich and complex. Resilient features like the Bois-Bougy endure, while other habitats have slowly disappeared over time. This commune and region face a breach in terms of connection and indigenous habitat loss. Despite the great potential, the lack of proper urban ecology poses a massive challenge that needs to be addressed. The commune and various administrative levels have made efforts to adequate the urban development as well as biodiversity strategies and plans to respond to these issues.



Vision d'ensemble Grand Genève 2040 © Grand Genève, 2021

Current land-use planning

Nyon is situated in a privileged location in the Lake Geneva region. Due to its proximity to the Geneva canton and being part of the Vaud canton, the coordination of its growing urban settlements and demographic rise is done at a multi-scale level. This city and region play a key role through its participation in the creation or collaboration of urban development projects. Nyon is part of plans such as the Greater Geneva Conurbation Project (*Projet d'Agglomération du Grand Genève*), the Cantonal Master Plan (*Plan directeur cantonal*), the Nyon District Regional Master Plan (*Plan directeur régional du district de Nyon*), the Master plan for the Nyon conurbation (*Schéma directeur de l'agglomération nyonnaise*) and the Municipal Master Plan (*Plan directeur communal*). The next brief introduction to these projects will paint a portrait of the short-term future of the city and the region.

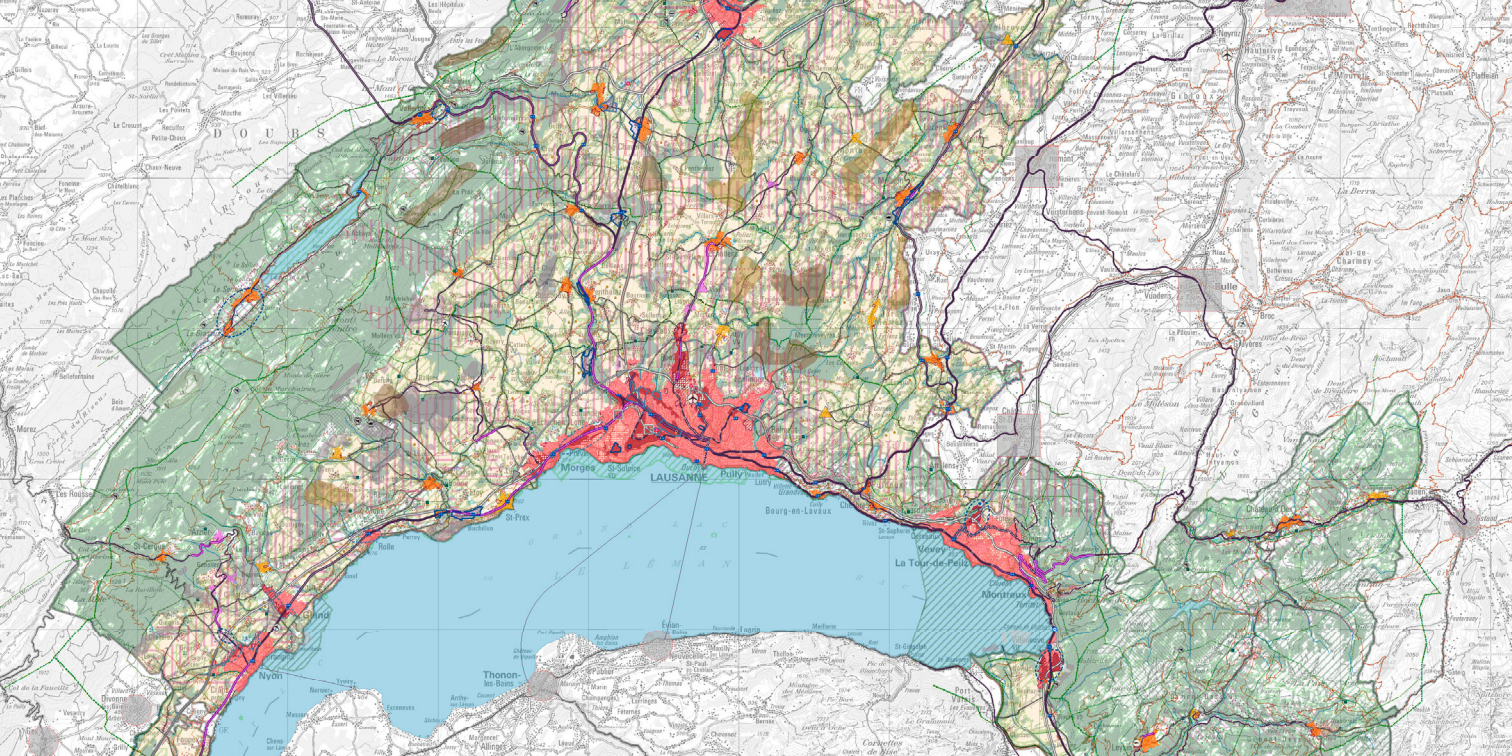
Projet d'Agglomération du Grand Genève

Ever since the 1970s, the efforts of territorial structuring have been executed in the region. As of 2013, the creation of the Grand Genève local cross-border cooperation group and its associates, the Swiss Confederation and the French State, have participated in the organisation and plan of the territory by executing studies, projects and actions under three main axes: mobility, urban development, and environment and landscape. The cantons of Geneva and Vaud, the Auvergne-Rhône-Alpes region, the Ain and Haute-Savoie departments, the city of Geneva, the Nyon region, and the French Genevan metropolitan cluster (which includes the Pays de Gex, Thonon-les-Bains and Annemasse conurbation communities; and the Pays Bellegardien, Genevois, Arve et Salève, Pays Rochois and Faucigny-Glières communities) participate in these crucial actions from which *Projets d'Agglomération du Grand Genève*, or Greater Geneva Conurbation Projects, result.

These strategies, developed since 2007 and renewed every four years, look to develop public transport systems adapted to the existing urbanisation. The projects are part of the backbone aiming for sustainable growth of the Swiss territories (Grand Genève, 2023) as they consist of the proposal of strategies with specific measures attacking important urban issues.

So far, four projects have been produced. The ongoing plan, the fourth-generation Conurbation project, is a continuity of the previous plans, but for the period 2024-2027. The main focus is to consolidate and strengthen the networks in Greater Geneva, and to prepare the future development. In terms of mobility, the actions will centre on the creation of multimodal interfaces of local centres, the use of soft mobility to train stations, the completion of the structuring of the public transport network, the promotion of soft mobility, and the preparation for the Cornavin station extension. Regarding urbanisation, an enhancement of the quality of urban spaces to encourage proximity practices is planned. Lastly, the integration of issues related to global warming, nature in the city and the reduction of the nuisance in urban spaces is contemplated for the environment-landscape axis (Grand Genève, 2023).

All implicated parts of the Conurbation project have the same 2040 vision: a greener, multi-polar, compact, cross-border city of short distances. For this, specific strategies concerning the three main topics have been developed. For landscape and environment, the general actions include ensuring ecological corridor continuities, the promotion



Carte de synthèse - Plan directeur cantonal © État de Vaud, 2022

of sustainable agriculture and the development of urban peripheries. It is proposed to prioritize the role of landscape and environment in projects, especially as the regeneration of built environments is proposed. Regarding urbanisation, the territorial changes consist of the limitation of urban sprawl, the preference for compact cities, the locating of the main development sites in the multipolar structure of the region, and the definition of new territorial agreements. For this, cities are invited to create a favourable local and diversified economy, place economic activities in urban zones, and the strategic planning of commercial equipment for city centres. The densification of the city through the adaption of densities and urban forms to the context and the quality enhancement of public space meshes is considered imperative. Finally, mobility is tackled by the preparation of new railroad projects, the adaption of the regional road system at a national level, the reinforcement of public transport for multipolarity, the strengthening of cross-bordering bicycle networks, and the facilitating of multimodal transports. Urban centres are expected to calm their traffic, coordinate parking, promote pedestrian mobility and set a freight strategy.

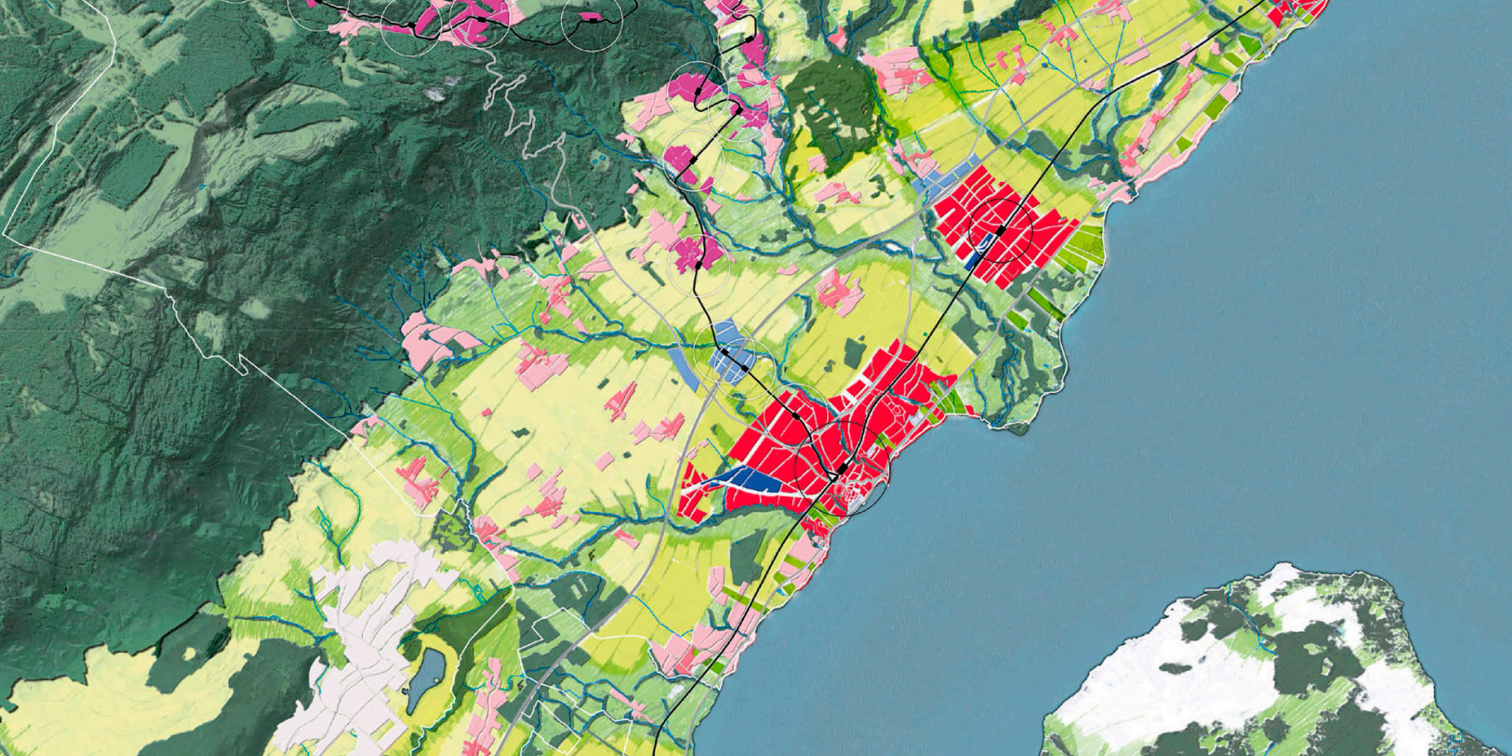
The project introduces coordinated conurbation development areas or PACA (*Périmètres d'aménagement coordonnés d'agglomération*). Nyon is included in the Geneva – Rolle perimeter where several measures are scheduled from which we can find the upgrading of the Route de Suisse in Prangins and Gland, and the improvement of public transport services and soft mobility in the Route de l'Étraz.

Plan directeur cantonal (PDCn)

The Cantonal Master Plan (*Plan directeur cantonal*) is described as a strategic instrument orienting the organisation of the cantonal territory in the next 15 to 25 years. It coordinates activities of great influence on the territory and the environment (Canton de Vaud, 2023). The first edition was approved by the Grand Council of Switzerland on May 20th, 1987, due to an urgent necessity for organisation after the economic crisis of the 90s. This document proposes guidelines regarding the principal challenges of the Cantonal Territory Project: regional vitality, quality of life, solidarity and interregional balance. The objectives are quantified as the project embeds economic, social and environmental context changes. Organised in six strategies, it draws information from administrative statutes, studies, and regional projects. It responds to the goals and principles of the Federal Act of Spatial Planning (*Loi fédérale sur l'aménagement du territoire, LAT*).

The master plan is divided into three main dimensions of the territory. The first concerns housing, jobs and leisure (A, B, C and D); the second focuses on biodiversity (E), and the third dimension discusses resources (F) (État de Vaud, 2022) from which six strategies unwind. The schemes affect the two composing networks of the region: the urban and the ecological systems.

According to the most recent PDCn (2022), the urban network is stratified at regional, local and village levels which define the fund proportion for each. Strategy A is then introduced: to coordinate the mobility, urbanisation and environment. This considers three guidelines, which are to centralise urbanisation, the development of multimodal mobility, and the protection of the population and the environment against human-associated risks. Strategy B is dedicated to fortifying the vitality of city centres. Through the consolidation of the regional centre systems, the enhancement of national and international connections, the encouragement of the construction of attractive neighbourhoods, and the installation of public equipment. Furthermore, C was conceived for the support of a dynamic heritage through the valorisation of cultural patrimony and the ease of built heritage rehabilitation



Plan directeur régional du district de Nyon © Paysagegestion, 2008

out of the building zones. Finally, D is dedicated to the valorisation of the economic mesh by giving support to new businesses and the existing economic mesh and strengthening the leisure and tourism network.

On the other hand, the ecological network consists of superior or priority ecological interest areas and corridors that link these spaces. The canton extends over three major biogeographical regions, the Jura, the Plateau and the Alps, which provide oceanic, continental and alpine climates (État de Vaud, 2022). The Master Plan has as its main objective to enhance the connectivity for biodiversity through its recognition during territorial planning but acknowledges its attractiveness for leisure and tourism activities. Strategy E focuses on the unification of nature, leisure and security. The guidelines include the valorisation of natural heritage and the annexe of ecologically valuable sites to the network. Finally, the actions in benefit of local resources assemble in strategy F, which aims to ensure the valorisation of resources in the long term. Within the actions, we find the preservation of agricultural lands, the support of agricultural and forestry economies, the encouragement

of sustainable resource exploitation practices and the promotion of renewable and native resources.

Each one of these strategies includes a set of actions conceived to meet the mentioned objectives where the responsibilities of the cantons, communes and other actors are specified.

Plan directeur regional du district de Nyon (PDRN)

The Nyon District Regional Master Plan is defined as a territory development tool for the communes of the district (Région de Nyon, 2024). After its proposal in 2011, it plans the coordination of urbanisation, mobility and environment for the next 15 years with specific operations published every four years. Considering the Greater Geneva Conurbation Project and the Cantonal Master Plan, the plan tackles three topics—landscape, mobility and lodging—located in nature, the country or cities and towns.

Strategy A's purpose is to preserve the landscape and natural resources. Due to the recent tendency of land consumption that affects rural zones and fractures natural and agrarian spaces, urbanisations that are non-adapted to environmental issues, highly car-driven mobility, and high pollution levels require a coordinated land-planning response conscious of resources, waste, land preservation and energy questions. Hence, the PDRN is not only interested in the preservation of the environment but also in local carbon footprint reduction (Conseil régional du district de Nyon & État de Vaud, 2010). By way of the acknowledgement of the environmental situation during land and project planning, and multi-level coordination with adequate institutions, six topics are addressed: context interaction of natural landscapes, valorisation of local resources, renewal of energy sources and economy, waste and nuisances, risk management, and the behaviour shifts to promote.

The *Places to live* strategy (B) oversees the organisation of a mixed and dense development through a sensible growth distribution adapted to the needs of the territory. The achievement of rational diversity—social, generational and functional—is a priority. Following the same line, densification is used as a tool to group and distribute services and accessibility according to the context. Consequently, the themes of development to implement, enhancement of the network of public and collective spaces and equipment, valorisation of cultural heritage and conservation of socioeconomic activities are discussed.

Lastly, C focuses on the increase and progress of complementary services of transportation and territorial coordination of mobility services. Having the reduction of automobile

flux and the decongestion of road systems as a priority, the strategy aims to favour public transport or soft mobility use. Then, settlements would grow according to the public infrastructure. In this case, multi-level coordination is needed as actors come from federal, cantonal, communal and inter-communal backgrounds. This point has several specific objectives: efficient public transport, attractive soft mobility infrastructures, controlled individual motorised transports, leisure activity centres connected to public transport systems, and behavioural shift promotion regarding mobility.

Schéma directeur de l'agglomération nyonnaise (SDAN)

Organised by the Nyon conurbation—Nyon, Crans-près-Céligny, Duillier, Eysins, Grens, Prangins, Signy-Avenex and Trélex—it coordinates the urban, mobility and landscape development in partnership with the canton by worksites where growth, public space and soft mobility projects take place (Ville de Nyon, 2023a). The SDAN has stipulated a series of responses to territorial and institutional challenges. The first reacts to the demographic rise and looks to preserve the charm of the city centres, the decongestion of the road system, the control of nuisances and social inequalities, and the adaption of mobility. It proposes selective growth contributing to the identity of the conurbation, the focus on already urbanised areas for the new development, expansions respectful of the existing landscape, sensible projects regarding urban and landscape values, mobility structures for a decrease of the use of motorised vehicles, and the development of urban structures along the needs of the public transport systems (Comité de pilotage pour le Schéma directeur de l'agglomération de Nyon (COPIL), 2006). Differently, on an institutional level, the goal is to promote collaboration between the communes, the region, the state and private parties.

The SDAN proposes three key ideas to position the conurbation with the creation of a communal identity, the creation of new areas adapted to the historical and urban tissues while respecting farmlands, and the conservation of small-village identities along with the conurbation. Simultaneously, the plan proposes objectives according to concepts. The landscape and urban notions share the same ambition of preserving and highlighting the values of the region responsible for the quality of life. The aim concerning public transport is to create an attractive network in coordination with the city. Finally, the concept of individual motorised transport suggests controlling these fluxes whilst protecting neighbourhoods and small towns by the promotion of public transport services.

Plan directeur communal (PDCom)

The Municipal Master Plan is a land-use planning tool defining the development of the commune of Nyon for the following 10 to 15 years. The latest version, also called Nyon 2050 was finished in 2023 with the ecological transition as a principal theme (Ville de Nyon, 2023b). This plan is composed of four key principles compiling the following issues: natural and historical context, urban fabric, urban public space, and mobility and parking.

The natural and historical context principle is divided into geography and topography (A), and archaeological remnants and cultural richness (B). About A, it is considered that the marking of natural and topographical elements should be preserved as heritage. Hence, they are to be considered during land planning as places of project or conservation potential. The elements of interest listed consist of the characteristic terrain level variations of the commune; the rivers, streams and wooded strips from which the Asse, the Cossy and the Boiron are found; the Lake Geneva (Léman), and viewpoints. Concerning the historical remnants (B) the efforts focus on the historical and modern city and archaeological zones. For the historical ones, the plan considers the preservation of notorious monuments and the highlight of the less known, as well as the requalification of negatively impacted spaces due to automobile use. The modern city plan includes the balance of activity diversity and identity throughout the commune and variable rehabilitation or protection projects for the archeologic zones.

The urban fabric is tackled from various angles. The qualitative efforts centre on the protection of the visual character of the historical village and the ambition of guiding the modern part of the settlement towards a clearer and harmonious aesthetic. The quantitative actions correspond to an administrative division of the commune into twenty-three sectors that will regulate demographic growth, the creation of jobs and the enhancement of quality of life through public spaces and equipment. Lastly, the densification of the urban fabric aims to control the city sprawl. The future urban development of the city seeks to contain the settlement within today's limits and to acknowledge and benefit from the natural spaces through the densification of the built space (Ville de Nyon, 2004). Nonetheless, this action will progress according to the context and the capacities of the built environment.

Similarly to the urban fabric qualitative issues, the public space is also to be preserved in the old town but has to improve in the most recent zones. Through the restructuring and hierarchisation of urban connections along with new public spaces, the strengthening of the

existing areas of interest and the treatment of the city's entry points (Ville de Nyon, 2004), the commune's public space will be revitalised and interesting throughout its entirety.

According to the Municipal Master Plan (2004), mobility and parking matters are addressed through the following objectives: guaranteeing generalised accessibility, especially in the city centre; an urban development with controlled travel flux, the control of traffic flux through good planning and road system organisation, the protection of neighbourhoods from traffic pollution, the improvement of quality of life in the city centre through efficient transport, giving appropriate conditions to soft mobility routes, and the implementation of adequate parking policies.

Biodiversity strategies and plans

In the past years, a growing concern about progressing towards an ecological transition has become more and more present, and this is no exception for the commune and region of Nyon. Actions and strategies have been developed to pave the way to a *greener* future, along with the creation of new roles and office branches dedicated to environmental-related matters. For instance, the *Nyon s'engage* climate change response plan traces a path of action by prioritising projects of high potential. Tackling issues such as building energy consumption, climate change, mobility, raising awareness, and organisation, the community will react proactively, efficiently and within real capacities.

Nonetheless, it is since 2011 that Nyon's responses started. Even though punctual projects were implemented, it was not until the *La Nature Demain* cantonal report of 2004 and the aforementioned Inventory of the Natural Values of Nyon's municipality of 2011 that the first official action plan was born. The *Stratégie Nature en Ville de Nyon* or the Nature Strategy for the city of Nyon suggested a course to follow for the 2011-2016 span. Given the information obtained from the reports and inventories, areas of ecological importance were identified and targeted for a revitalisation and connection program.

The focus areas were defined as the three watercourses—the Asse, the Cossy and the Boiron—, the embankments of the railways, the lakeshore, the Bois-Bougy forest, the urban green spaces, the farmlands, and the facades and old walls of the historical centre. The preservation, reestablishment and boost of the diversity of species and environments; the development of urban ecologies; the preservation and valorisation of natural habitats as



Communal vegetable garden - 46°23'16.8"N 6°14'11.3"E

their connection, the control of invasive species, the integration of biodiversity into projects, and the financing of the projects detailed in the action plan were defined as the seven main goals (Ville de Nyon & Services de Travaux et Environnement, 2011).

After the end of the valid period of the latter, the current *Stratégie de Biodiversité 2022-2030* was devised to resume and solve some difficulties, such as the need to improve the strategic document where measures would be planned and described clearly to meet defined objectives (Ville de Nyon & Service de l'Environnement, 2022). At the same time, it was integrated into a global strategy on a cantonal and national level for harmonisation with the Strategy of Swiss Biodiversity 2019-2030, and the Action Plan of Biodiversity in Vaud 2019-2030. This document describes seven goals with their respective eighteen measures result of the report of the *Stratégie Nature en Ville de Nyon* of 2011, workshops with local collaborators, the ambitions of the concerned departments, and the national and cantonal plans.

The first objective consists of the preservation and growth of the urban ecological infra-



Bug hotels in Nyon - 46°23'13.4"N 6°14'24.5"E, 46°23'15.4"N 6°14'11.7"E

structure. By identifying the existing ecological infrastructure, it can be added to land-use design documents, where it will be protected and integrated into territorial planning. The second goal is to manage green spaces and forests sustainably. The actions derived from the latter consist of the maintenance of each green surface according to their ecological interest or priority species, awareness-raising of the local population, the use of climatologically adapted plants, pro-biodiversity measures for forested or wooded lands and the conservation of the tree patrimony. The third point regards the expansion of urban ecology through the encouragement of designers and private owners to integrate efforts to benefit biodiversity in projects. The next action concerns climate change and the reduction of heat islands by the location of conflict areas to target for greening or making them permeable, and the promotion of greening of private properties. The fifth, sixth and seventh objectives consist of the management of exotic invasive species, the monitoring of biodiversity through the update of inventories and studies, and its promotion, respectively. The latter includes the development of annual programs where visits, animations, and other activities would be



Landscaped area of urban meadows near Nyon's train station - 46°23'07.5"N 6°14'08.2"E

performed to acknowledge the value of nature. In contrast with the previous plan, this strategy is dynamic and will potentially add projects as opportunities arise. It will be complemented with supervision of the progress made for each measure undertaken to formulate a report for the end of the term (Ville de Nyon & Service de l'Environnement, 2022).

The implementation of guidelines for the benefit of the environment is the keystone for an effective ecological transition. Continual application, reinforcement and improvement are imperative, especially in today's critical scenarios. As stated throughout the previous chapter, architects, urban planners, and other implicated actors' participation is crucial for the enforcement of these measures. A collaborative and multi-scale involvement will contribute to preserving ecosystems, fostering resilience against climate change, and securing sustainable modes of living where humans and non-humans will coexist harmoniously.

In practice

In conversation with Albertine Roulet,
environmental project manager for the
Environment Department of Nyon

Nyon is quite interesting on a territorial level because it is framed by two massive biodiversity reserves which are the Léman (Lake Geneva) and the Jura. Additionally, Nyon has two wooded strips and two rivers that surround the urbanisation. Since the scale of the city remains small, agricultural lands are reached easily. Nowadays, we are working in urban areas to create functional connections between the two reserves in hand with the agroecological regions. These allow us to create these links but on a greater scale.

Our efforts include the two corridors: the Boiron and the Asse, which will become the city's biodiversity hotspots and that is necessary to preserve and reinforce. We also resolve ecological issues derived from private properties by raising awareness and talking with building managers and owners about pro-biodiversity garden maintenance. With financial support, sensitisation, and the implication of private parties, the capacity for action increases. Sadly, our field of activity is limited because of cadastral boundaries and underground complications. Also, we organise events and activities to convince people to make changes to their plots. Not only regarding the planting of native species and the removal of invasive ones but also in the management of physical obstacles for wildlife.

Today, the canton has asked for the identification of the ecological infrastructures, and we have found that it was a valuable exercise to perform on a communal scale. For the canton, one of the few spots of interest would be the Boiron, but if we reduce the scale, other significant areas resurface. We determine the best 30% of the territory for biodiversity and divide it into central or networking areas. We strive to achieve the 30-30 objective, to give 30% of the territory to biodiversity in 2030. As the local ecological infrastructure is identified, so are gaps or conflict areas, and that is when we can propose project priority zones. The commune is working on the next PDCom (*Plan directeur Communal* or Municipal Master Plan) and since we have just finished defining our ecological infrastructure, we have the opportunity to integrate this information into the territorial project.

Vaud's ecological network traverses the territory through the La Frontière agroecological region that is out of our administrative borders. Yet, we try to work with every chance we get, especially on intensive agricultural lands that are an almost no man's land. As the Environment Department, we are starting to be consulted for projects, and we hope that it will become the norm. The main problem is that everyone is always supportive of environmental matters, but not when it implies a cost or restrictions. If these questions were addressed from the beginning, the problems would be reduced drastically.

Regarding some ongoing projects, we have the renaturation of the Asse which is crucial

because it is heavily privatised. Another important focus of our work is the development of a wetland network that is missing in Nyon's territory. There is also a shoreline renovation plan since the only natural shore is 10 metres long, and invasive species removal actions allow us to work in the city. Of course, there is always resistance from certain actors that prioritise economic benefits, but it is something that we are battling constantly. It is through communication that we look to trigger a change of mentality. For instance, for disappearing habitats, such as meadows, we try to preserve, highlight and strengthen them by their implementation in parks. People tend to think that those are unkempt areas when they are intentional. When explaining the situation, people start to understand that the cohabitation of natural and leisure spaces is possible. To trivialise the quotidian secrets of nature by making them and their evolution visible along with working with people whose mentality considers the ecological transition is truly important.

21.11.2023

Landscape interpretations



Landscape ecology

Landscape ecology has a unique role to play in our lives. When we focus on the heterogeneity in a landscape, we sense how intertwined its ecological systems are. An action here and now produces an effect there and then. Since the system is interlocking, it is critical to understand the spatial relationships among the landscape elements; the flows of species, energy, and materials; and the ecological dynamics of the landscape mosaic. Thus, an understanding of the whole—landscape ecology with its practical tools for scholars, citizens, and decision-makers—emerges.

Richard T.T. Forman and Michel Godron (1986)

Landscape ecology is considered the groundbreaking starting point of the studies of the spatial dynamics of landscapes. Richard T.T. Forman and Michel Godron developed what is still considered an active tool for planners, designers, and land-use managers. It aimed to create a new common language to facilitate the communication and collaboration between the participating actors of the understanding, conception, and management of the landscape. It is the mediating role between natural sciences and landscape planners (Forman & Godron, 1986).

In October of 1983, Forman published his opinion on behalf of the American Institute of Biological Sciences where he expressed that landscape ecology centres on spatial relationships between landscape elements or ecosystems; energy, mineral nutrients and species among elements; and the landscape mosaic's ecological dynamics through time (Forman, 1983). Structure, functioning and change were the challenges of this new and developing research.

This new discipline was conceived as the origin of a constantly growing body of landscape ecology theory which would only be expanded from generation to generation. The authors created this theoretical base for students and professionals of different fields to lead to discussion, controversy, hypothesis, observation, experiment, modelling, and fact. And as we will see in the following chapters, they fulfilled their goal.

Origin and definition

The term *landscape ecology* was first used by the German geographer Carl Troll in 1950 when aerial photography began to be widely available, and it focused on the landscape's spatial patterns where biological communities encountered the physical environment (Dramstad et al., 1996). Forman and Godron consider the roots of the discipline to be found in every period of history. Yet, more precise contributions can be traced in the works of multiple professionals of diverse backgrounds, going from Germany, the United States, Switzerland, Russia, and the Netherlands. Landscape ecology has always been served from the relevant work of neighbouring disciplines such as ecology, geography, animal and plant geography, regional studies, planning and landscape architecture, land evaluation techniques, biology, forestry, and pest management.

As stated by Forman and Godron (1986), this theory recognises the landscape as a heterogeneous area composed of interacting ecosystems repeated throughout. Its development or genesis results from geomorphological processes, organisms' colonisation patterns, and ecosystems' local scale disturbances over time. Compared to other landscape ecologist theorists, landscape ecology uses the term *landscape elements* referring to relatively homogeneous, ecological elements or land units of natural or human origin. These elements can be recognised as heterogeneous, in which *tesserae* can be found. These are the smallest homogeneous visible units of the spatial scale of the landscape (Forman & Godron, 1986). For this approach, the landscape comprises somewhat homogeneous ecosystems in natural or human-influenced spaces.

Scope and range of action

Landscape ecology understands the territory through elements that are identifiable in aerial photography and range from around 10 m to 1 km or more in width (Forman & Godron, 1986). The discipline considers the landscape as a variable kilometre-wide mosaic of any nature and uses two main scales: the landscape and the region. Both are land mosaics composed of spatial elements, but those at landscape scale are landscape elements, while those at regional are landscapes (Forman, 1995). The principles proposed, which will be explained further down, apply to all types of areas, from the most pristine natural areas to zones of intense human activity. Even though the majority of these conventions can be used to read landscapes of all scales, localised areas of a few metres to hundreds are considered to be of a finer scale and therefore not always suitable.



Crans-près-Céligny, Lac Léman, view to the east (E) © Swissair Photo AG, 1984
Part of Nyon's landscape mosaic. Elements such as patches, matrices and corridors are visible.

Main principles

According to the works of Forman and Godron (1986), the landscape is a specific and measurable unit defined by a group of recognisable, repetitive, and interactive ecosystems sharing geomorphology and disturbance regimes. Living systems exhibit the following three main characteristics, and landscape as such, is defined by them as well: structure, function, and change.

The landscape is viewed as a mosaic composed of elements where biodiversity patterns and natural processes occur, responsible for movements, flows, and changes. The removal, alteration or permanence of landscape elements are evident in land transformation, such as perforation, dissection, shrinkage, attrition, and coalescence, which all result in the modification of existing flows and functions of ecological and human implications.

Structure

The spatial relationships among the distinctive ecosystems or “elements” present—more specifically, the distribution of energy, materials, and species concerning the sizes, shapes, numbers, kinds, and configurations of the ecosystems.

Richard T.T. Forman and Michel Godron (1986)

The structure is the spatial pattern or arrangement of the landscape elements which fall into the category of patch, corridors, or background matrix. In these, ecological objects (such as flora, fauna, energy, and minerals, among others) are diversely distributed and vary in configuration, type, number, shape, and size. To detect these spatial arrangements is to comprehend the landscape's structure (Forman & Godron, 1986).

These spatial structures can show a high level of heterogeneity or variation of landscape ecosystems. This can result in a low level of rare interior species, and an abundance of edge and multi-habitat species (Forman & Godron, 1986). The general diversity level of the mosaic might be high due to ecosystem interactions and not because of the individual diversity of ecological objects.

Functioning

The interactions among the spatial elements, that is, the flows of energy, materials, and species among the component ecological systems.

Richard T.T. Forman and Michel Godron (1986)

The functioning is the movement and flow of ecological objects through the structure (Dramstad et al., 1996), which are tightly linked. Disturbances, natural or human, cause changes in species distribution, and these later eliminate, change, or create landscape elements. Perturbations affect sensitive species' distribution while favouring the spread of others into the concerned areas. This heterogeneity is fundamental to understanding species' movements and flows (Forman & Godron, 1986).

Furthermore, disturbances are important causes of mineral redistribution. Severe perturbations can disrupt the ecosystem's mechanisms for conserving and regulating mineral nutrients (Forman & Godron, 1986), increasing the circulation of minerals among landscape elements. If these perturbations increment the heterogeneity, the flows of energy and biomass across the boundaries of landscape elements increase as well.

Change

The alteration in the structure and function of the ecological mosaic over time.

Richard T.T. Forman and Michel Godron (1986)

Over time, change refers to the alteration of spatial patterns and functioning (Dramstad et al., 1996). These disturbances affect the horizontal structures and the stability of the landscape according to its severeness. When left undisturbed, the structures move progressively toward homogeneity through plant and animal colonisation and soil modification. Moderate disturbances increase the heterogeneity of the structure; while harsh perturbations can either increase or decrease heterogeneity.

On the other hand, stability refers to the resistance of a landscape to perturbations and its recovery from them (Forman & Godron, 1986) and it is related to its proportion in the landscape mosaic. The stability varies depending on the level of biomass or ecological objects present. In the case of the absence of biomass, a system can become biologically and physically constant; when a low level of biomass is found, there is rapid recovery from disturbance; and finally, with high levels of biomass, a system might be vastly resistant to perturbation, but recover slowly from it (Forman & Godron, 1986).

Spatial structures

Landscape ecology offers a set of *landscape elements* which are always present in the landscape and form the mosaic. As stated by Forman (1995), all points in a landscape are inside a patch, a corridor or the background matrix of any land mosaic. These structures are produced by flows, which simultaneously determine flows and movements. Movement and flows then provoke changes in the land mosaic over time, and so on.

The following spatial structures will be illustrated with photographs taken on-site and iconography able to support and visually demonstrate the described concepts. This will be complemented with a cartographic exercise. The two scales (landscape and region) will be explored in Nyong's context to formulate a general comprehension of the theory through written and visual forms. The compilation will not be an extensive and in-depth description of all the theories proposed by landscape ecology. Instead, it aims to create a deeper understanding of the landscape and some basic notions of biodiversity dynamics for architects and urban planners through the lens of ecologists and experts in the field.

Patches

We may define patch as a nonlinear surface area differing in appearance from its surroundings. Patches vary widely in size, shape, type, heterogeneity, and boundary characteristics. In addition, patches are often embedded in a matrix (...)

Richard T.T. Forman and Michel Godron (1986)

Plants and animal habitats can appear as scattered patches in the landscape. They always appear somewhat isolated and differ in size, number, and location, which can have positive or negative effects. The mechanisms and origins resulting in patches are always related to disturbances, environmental heterogeneity, and human activity impact, and they develop into differences in species dynamics over time (Forman & Godron, 1986). Simultaneously, the elements in an ecosystem can undergo different processes that affect the rate at which they appear and disappear. This is known as patch turnover.

Patches are crucial landscape elements in constant change and evolution. They can be categorised according to their origins or causative mechanisms in four main types: disturbance, remnant, environmentally sourced, and introduced patches.

Disturbance patches

Disturbance patches result from, as their name indicates, a disturbance of a small area in the matrix (Forman & Godron, 1986). The perturbations can be due to natural changes, in which case they are unpredictable as they reflect internal and external environmental factors altering the patch area, or due to human activity. The dynamics emerging from a perturbation differ in the following possible responses: population sizes of species can rapidly change, positively or negatively; changes in the population of surviving species also occur, normally compensating for the loss of individuals; and immigration responses are triggered too. These three processes are all involved in the succession or recovery from the disturbance with a variable proportion of species implication. Ultimately, the sequence of responses ends in relative community stability when the patch has disappeared and converged with the matrix (Forman & Godron, 1986). In unusual cases with severe disturbance or with a rapidly changing matrix, succession can result in a semi-stable patch whose characteristics still contrast with the matrix. Nevertheless, because of high population changes and species immigration, attrition is imminent (Forman & Godron, 1981).

In comparison to the presented typologies of patches, these are short-lived, as they have



Les Muids, station, Chemin de fer Nyon-St-Cergue-Morez (NStCM) single wagon © ETH-Bibliothek Zürich, Bildarchiv, 1985. An example of a chronic disturbance patch that turned into a introduced patch over time.

the highest patch turnover rates or the lowest average age or persistence time (Forman & Godron, 1986). Nevertheless, these habitats can also originate from chronic perturbations resulting in a certain level of stability and, therefore, a long persistence time. Typically, chronically affected patches are caused by human activity, but can also be due to natural disturbances. In this case, the species in the element will adapt to the disturbance regime but will never be fully absorbed by the matrix. On the contrary, the patch will present distinctive ecological characteristics and will achieve an equilibrium with the surrounding matrix (Forman & Godron, 1986).

Remnant patches

According to Forman and Godron (1986), remnant patches are caused by widespread perturbations surrounding a small area, the inverse of the mechanism for the disturbance patch, but the remaining previous plant and animal communities are embedded in a disturbed matrix. In both cases, the habitats were generated from disturbance, either human or natural, but one was directly damaged and the other one, indirectly. At first, vegetation or animals of remnant patches suffer from large changes in population size, immigration, and extinction, and are later followed by succession.

Similarly to disturbance patches, remnants experience the same sequence of responses and have a high turnover rate. The relaxation period, the time when the extinction rate is elevated after a disturbance, affects species of low population sizes and/or with large territory requirements. This is part of an adjustment period characterised by an elevated rate of species dynamics which may extend throughout the life of the patch, that is, until the patch converges with the matrix (Forman & Godron, 1986). However, if the perturbation is rapid, the patch might go through minor changes in species composition (Forman & Godron, 1981).

Chronic disturbances, of natural or human origin, are also producers of this type of patch. Time plays an important role in the species' dynamics and changes through the adjustment period. The longer a remnant patch with a low population size exists, the higher the risk of local extinction. Then, chronic remnant patches usually have longer relaxation periods and higher species loss than short-lived remnant habitats (Forman & Godron, 1986).

Environmental resource patches

In contrast to the two previous patches of disturbance origin, environmental resource patches are stable and unrelated to disturbance, their origin is due to the heterogeneous or patchy distribution in the space of environmental resources (Forman & Godron, 1986). They are characterised by their diffused boundaries; their ecotones may be wide and exhibit a changing gradient.

As stated by Forman and Godron (1986), since the distribution of resources is relatively permanent, the patches are also permanent, and their turnover is acutely low. The dynamic processes of population variation, immigration, and extinction are present but at a low level



1260 Nyon - 46°22'40.2"N 6°13'24.4"E

An environmental resource patch (background) and a planted introduced patch (front).

with a non-existing adjustment or relaxation period. The changes are of normal occurrence for a patch in equilibrium with the surrounding matrix.

Introduced patches

Introduced patches are the most widely spread on Earth, as they originate when humans insert new ecological objects into an area. The two main types of introduced patches are planted, and homes or habitations.

Planted introduced patches happen when humans, as the name indicates, introduce vegetation into the matrix. Due to their origin, the species dynamics and turnover depend on the maintenance activities of people. In case of abandonment, the patch would be invaded by the species of the matrix until its incorporation with it, where some introduced species could remain dominant for some time and decelerate the successional process (Forman & Godron, 1986). A normal sequence of dynamics unfolds as follows: a brief initial period of



1260 Nyon - 46°23'04.9"N 6°14'43.6"E

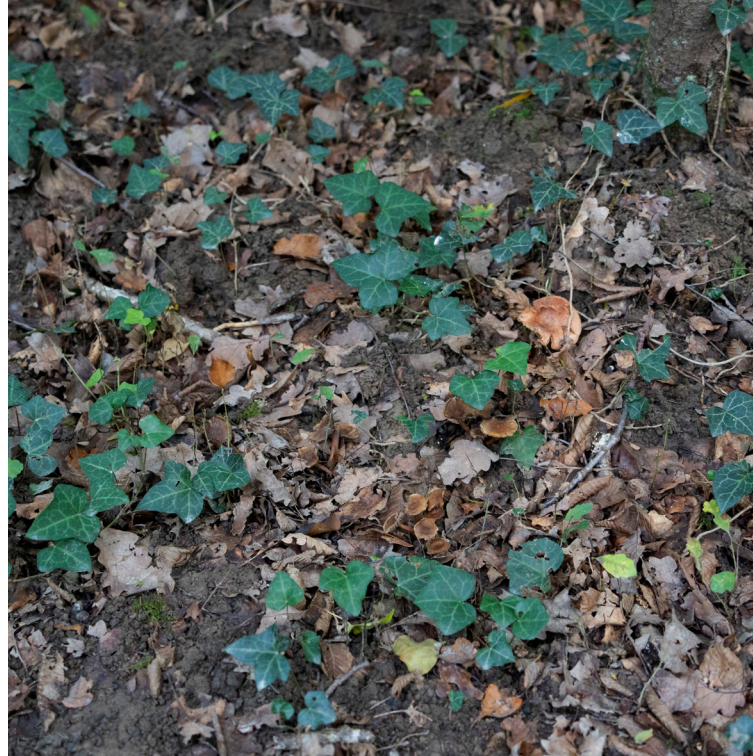
The Asse stream crosses an introduced patch of habitation areas.

severe change due to disturbance and planting, continuing with a long time of stability as it is maintained, and ending with a moment of important change during abandonment and succession (Forman & Godron, 1986) as explained above.

On the other hand, homes or habitations are areas of primarily human activity whose natural ecosystems have been partially or completely erased and replaced with an artificially built environment and the introduction of new species. The ecological structures found in these patches are dependent on the introduced species. Its ecosystem includes four main types of species: people, introduced plants and animals, unplanned pests, and immigrating native species (Forman & Godron, 1986). These, as planted patches, are completely reliant on human maintenance for their survival and lingering.

About size, shape, number, and configuration

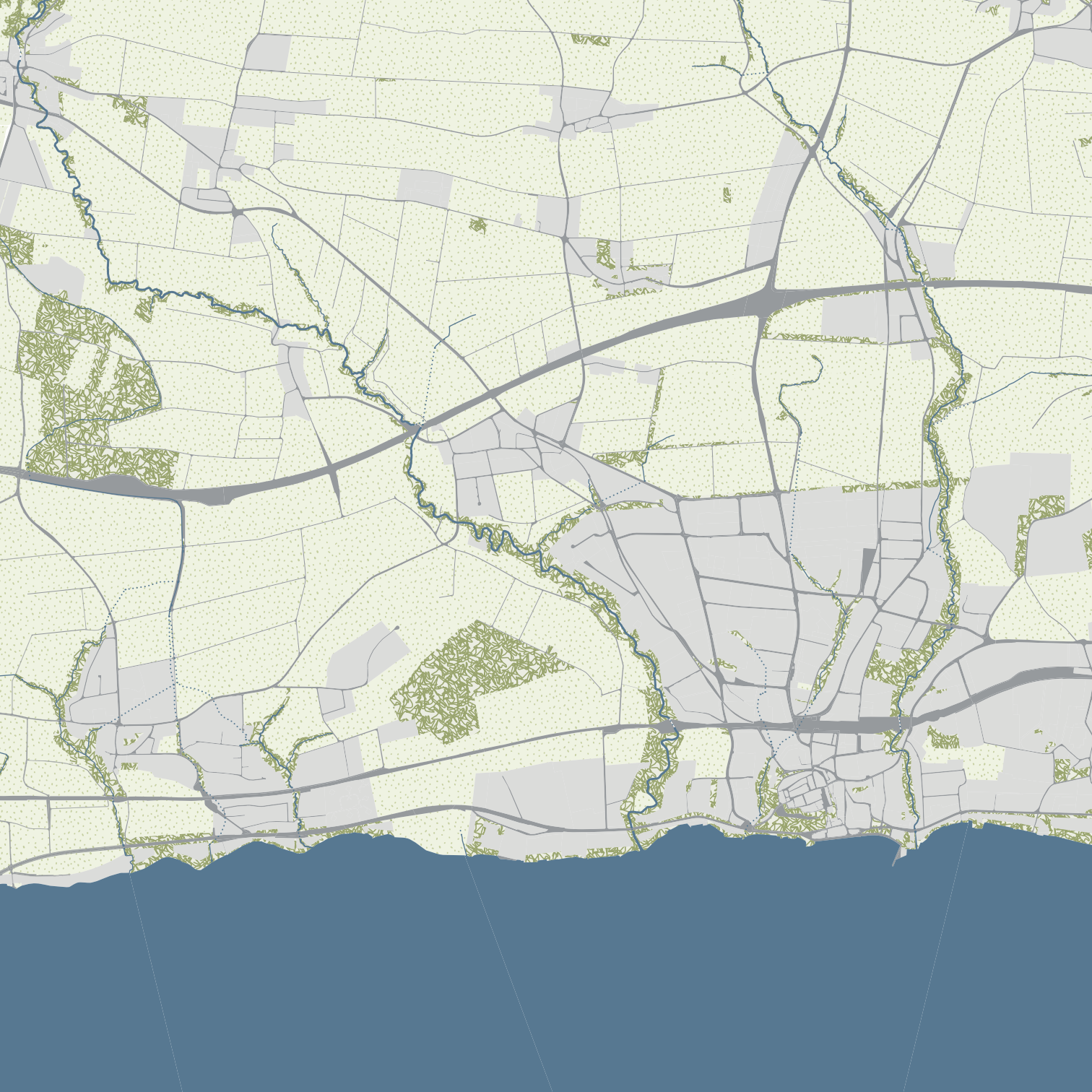
Patches are analysed and studied through three main aspects: size, shape, and number



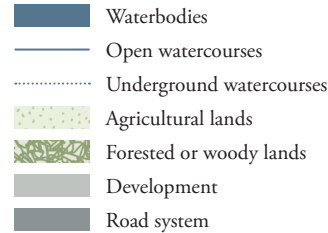
Bois-Bougy, Nyon - 46°23'04.9"N 6°14'43.6"E

Interior of the Bougy woods showing some possible tree interior species (left) and of Ivy (*Hedera*), an edge species (right)

and configuration, and they all affect the edge effect of the element. The edge of a patch is an outer band whose environment is greatly different from the interior of the patch (Forman & Godron, 1986) where edge species are found and high animal activity happens. The latter are exclusively or primarily on the perimeter, whereas the interior species are located normally away from the perimeter of the patch (Forman & Godron, 1986) and can be of conservation importance. The width of the edge is affected for a variety of reasons among which we can find the angle of the sun, wind direction, its vertical structure and even patch age and soil conditions. Edges function as filters, modifying how the surrounding influences affect the interior. When the edge is abrupt, it promotes movement along it, while a diffuse or *tiny-patch* boundary facilitates movement across (Dramstad et al., 1996) and provides numerous ecological benefits—the more convoluted, the higher the proportion of edge habitat and interaction with the surrounding matrix.



Map 01: landscape ecology principles in macro scale - Nyon commune and surroundings



Notes

About watercourses

The information used to illustrate the waterways comes from a survey for the Projet d'Agglomération of Grand Genève. The layers contained piped watercourses, groundwater water flows, underwater bodies and others not identified, all the mentioned above were grouped in the "Underground watercourses" layer, as a difference did not need to be made.

About representation

The method of representation chosen was inspired by the maps found in the book *Landscape ecology principles in landscape architecture and land-use planning* by Wenche E. Dramstad, James D. Olson and Richard T.T. Forman. There, the authors propose a similar legend to portray a hypothetical landscape.

About scale

The frame of this map was chosen to portray the landscape from a commune distance, to show the three most important streams of the area connecting to the Léman, and to display certain important woody or forested patches.

Remarks

Through this theory, the most marking elements of the landscape mosaic are identified. The contrast between the elements is high, as there are significant differences in habitat typologies. As it will be clarified throughout the theories description, it can be said that this portrayal corresponds to a coarse-grain vision, as subtler particularities of the patches are disregarded.

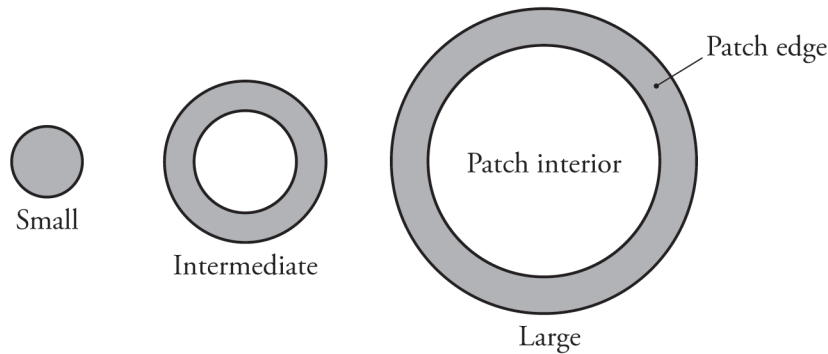
So far, this map showcases two types of a landscape element mentioned above. Patches are found in the form of environmental resource patches in *Forested or woody lands*, and as introduced patches in *Development*. They are of all sizes and mostly of isodiametric, elongated and narrow elongated shapes.



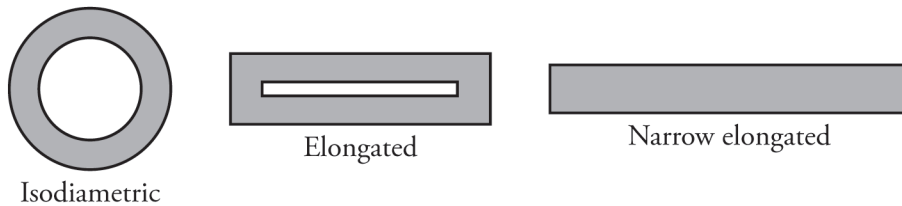
0 km

+2

Size



Shape



Patch shapes and sizes (Redrawn from diagram *Interior and edge areas as affected by patch size and shape* © Richard T.T. Forman, 1981)

Size is one of the most recognisable features that affects how energy, nutrients and species are distributed and move. The number of ecological objects is proportional to the area of a patch; therefore, large habitats contain more of the mentioned objects than smaller versions of the same element. Large patches of natural vegetation are key protective structures for aquifers and stream networks, they sustain larger populations of interior species, provide refuge for large vertebrates, and allow near-natural disturbance regimes (Forman, 2008). Even though the probability of a species becoming locally extinct is higher if the habitat is of reduced size, small patches serve as stepping stones for species movement, they protect rare species or small habitats, and they bring heterogeneity in the matrix and habitat for species that prefer small patches (Forman, 1995). Large and small patches complement each other in the ecological benefits they give to the landscape.

Furthermore, the shape and orientation of the patch are as important as size in the dispersal and nutrition of organisms across a landscape. These shapes are categorised into three types: isodiametric and elongated, ring, and peninsula-shaped. The first one is normally either a circle or square consisting mostly of interior and a band of edge habitat on its outer portion (Forman & Godron, 1986). They are effective in the preservation of

internal habitats and minimising external influences. When it comes to elongated forms, the interior-to-edge ratio is lower as the edge can eliminate interior habitats if too narrow. Ring-shaped patches are of circumpolar distributions where they encircle a different-natured patch. Ring zones' interior-to-edge ratio indicates they are more similar to elongated patches (Forman & Godron, 1981). Moreover, a peninsula is a narrow extension or a lobe of a patch that stimulates interactions with distant areas of the landscape. Also seen as truncated corridors, they normally function as a passage across landscapes being important areas of concentrated fauna movement, or as barriers between patches on the opposite sides (Forman & Godron, 1986).

Lastly, the patch number and configuration must be considered, as they do not exist commonly in complete isolation, but rather in groups. Hence, to understand their spatial configuration is to understand their interactions. A patch can be the source of disturbance, so its location among other patches will be crucial for the spread of the disturbance. In case of isolation, the perturbation will not go further; if next to other similar patches, the disturbance will rapidly spread; and if next to different-typed patches, they will act as a barrier (Forman & Godron, 1986). Assuming the second scenario of patch loss, its removal has an impact on the overall structure of the landscape, and it can lead to isolation. The metapopulation may experience local extinctions, slower recolonisation, reduced stability, and decreased habitat diversity (Dramstad et al., 1996).

Corridors

In the face of continued habitat loss and isolation, many landscape ecologists stress the need for providing landscape connectivity, particularly in the forms of wildlife movement corridors and stepping stones.

Wenche E. Dramstad, James D. Olson and Richard T.T. Forman (1996)

According to Forman and Godron (1986), corridors are narrow strips of land different from the matrix that can be isolated but are normally connected to a patch of similar vegetation. They divide and connect the landscape simultaneously, but their main roles are as routes or conduits for movement, as species barriers or filters, as habitats for certain species, and as sources of ecological effects on their surroundings.

Similarly to patches, they originate from mechanisms or disturbances. Therefore, disturbance, remnant, environmental resources, and planted and regenerated corridors exist.

They differ in origin, width, degree of connectivity, amount of curvilinearity, stream presence or whether they form part of a network (Forman & Godron, 1986), but their persistence or stability depends directly on the mechanisms causing it and their management. This applies to all cases except for environmental resources corridors.

Curvilinearity is one of the most distinct aspects of a corridor. The physical structure alters the dynamics along the element. For instance, straighter corridors shorten distances and speed movement in contrast to more convoluted or irregular elements. Some irregularities found come in the form of breaks, narrows and nodes. Breaks are long or short discontinuities of great impact on movement along and across corridors, narrows are areas where the element is shaped as an isthmus causing similar impacts to the latter irregularity; and nodes, or mini-nodes, are patches of similar vegetation linked to corridors (Forman & Godron, 1986). The primary measure of a corridor structure is its connectivity. The presence or absence of breaks in a corridor is crucial in determining its effectiveness as a conduit and barrier (Forman & Godron, 1986). Another method to understand this landscape element is through the degree of height difference of the species, which affects the edge effect of the corridor and its diversity. Not only do species variations exhibit transversally, but also longitudinally. As reported by Forman and Godron (1986), since corridors extend for some distance, gradual changes in species composition and abundance occur along the element due to environmental changes, colonisation or extinction patterns, or disturbances.

Corridors are also present in the form of networks. These systems are widespread in landscapes of great human activity. As isolated units, single corridors facilitate species movement, but networks provide a more efficient migratory system of alternative pathways. This is crucial for nutrition, predator avoidance, and minimising the barrier or isolating effect of a disturbance or break in a corridor link (Forman & Godron, 1981).

There are three basic types of corridor structures independent of origin, management and the type of habitat: line, strip and stream corridors. The following description comes from the basic concepts of this approach and aims to create its general understanding. No specific quantitative measurements will be done, as they require non-available data.

Line corridors

Line corridors are narrow bands dominated by edge species, but no species is completely restricted from them. The recurrent species found in these elements use them as breeding and habitat areas while using the surrounding matrix for nutrition and protection. These

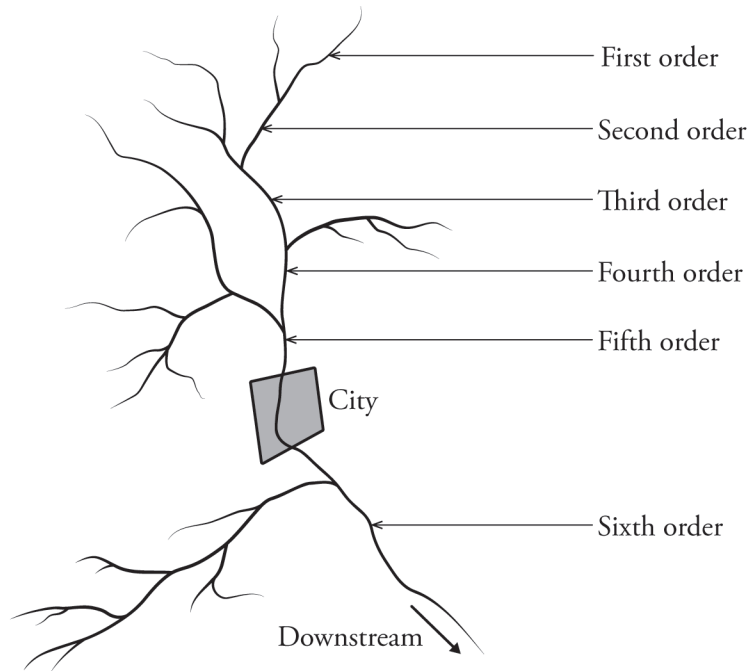


Nyon, Château de Changins © Aéroport de Lausanne, 1952
 Example of a woody linear corridor following a road still present in the landscape today.

corridors are vastly influenced by matrix-adjacent conditions, such as wind, human activity, species and soil characteristics (Forman & Godron, 1986), but are characteristic of landscapes of strong human disturbance (Forman & Godron, 1981). Hedgerows are deeply studied examples of linear corridors, but other types are roads, including roadsides or verges, railroads, dikes, ditches, powerlines, and herbaceous and shrubby strips for wildlife management. Since these originate from a chronic disturbance, their persistence is highly dependent on human maintenance effort. They commonly serve as barriers to subdividing populations of species; conduits for disturbance-tolerant species; and sources of erosion, sedimentation, exotic species, and human influences on the matrix (Dramstad et al., 1996).

Strip corridors

Strip corridors are wider bands compared to the latter, with a central interior habitat of rich diversity (Forman & Godron, 1986). The major ecological difference between line



Stream orders (Redrawn from diagram *Stream orders* © Richard T.T. Forman and Michel Godron, 1986)

and strip corridors is the width, this type is wide enough to present an edge effect on its outer areas and an interior zone that protects from natural predators, domestic animals and human perturbations. Even though they are less common than line corridors, they can be found in superhighways, wide strips of woods, and wide powerlines.

Stream corridors

Stream corridors border water courses and vary depending on the size of the water body they follow, they control water and mineral runoff, reducing flooding, siltation, and soil fertility loss (Forman & Godron, 1986). For it to perform the previous functions, the stream corridor should cover at least the flood plain, the banks above the plain, and the upland above the bank of at least one side. As their vegetation diverges from the matrix and depends on the width due to the edge effect, their functional contributions also differ.

Every waterway presents a certain stream order related to the drainage density and patterns



The Boiron River in Nyon

that have direct implications on biodiversity dynamics. As the stream order increases, the species change because of environmental changes like flow rates and oxygen levels. They also present flood levels and flood frequencies related to processes like flooding, droughts or sedimentation. If flood damage happens, widely spread stream corridor vegetation and animals adapted to variability in moisture and flooding are highly productive and can regrow rapidly because of nutrient-rich substrate deposited by the disturbance (Forman & Godron, 1986). The flora found in these elements provides certain conditions to the stream, such as shading, nutrients, and even diversity of water flows.

Stepping stones

Even though stepping stones are not directly categorised as corridors, but as a group of small patches not directly connected but in proximity, stepping stones are important elements of species' dispersal. Fauna movement is either continuous or saltatory, in comparison to the first one, the second exhibits high interaction at stops, which are divided into



1260, Nyon - 46°22'43.0"N 6°13'28.3"E

Example of a woody *tiny-patch* close to other bigger patches.

two types: rest stops and stepping stones. While rest stops exist when individuals arrive at a place and stay temporarily, stepping stones are colonised by the species, where they arrive, grow and reproduce (Forman & Godron, 1986). These elements are an intermediary point between a corridor and no corridor, and they work best when present in clusters. When in groups, they provide alternate or redundant routes while keeping linearly oriented arrays between patches (Dramstad et al., 1996). The effectiveness of movement between stepping stones depends on the capacities of each species. For instance, visually oriented species rely on their ability to see successive stepping stones, and the removal of one patch can inhibit movement and increase patch isolation.

Matrix

The matrix is the most extensive and most connected landscape element type, and therefore plays the dominant role in the functioning of the landscape.

Richard T. T. Forman and Michel Godron (1986)

As mentioned before, the matrix is the most prevalent element in a studied landscape, and it must be differentiated through its proportion, configuration and influence over other elements. The matrix is larger in total space and has concave boundaries surrounding other landscape components. It is interconnected with narrows where patches approach closely and have the main influence on the overall landscape (Forman & Godron, 1986). The area, connectivity and influence are the three principal criteria to identify the matrix.

The relative area is the first criterion to determine. When one element of the landscape has a visibly larger surface than others, it most likely is the matrix. The species dominant in it are dominant in the landscape as well, and it controls the flows found throughout. When an element covers more than 50% of the surface, it is the matrix; if it covers less than 50%, other characteristics must be considered (Forman & Godron, 1986).

Based on the second case mentioned above, the connectivity of a given element must be evaluated. When one element is almost perfectly connected and encircles the others, it is very likely the matrix. Nonetheless, matrices are seldom completely connected but rather divided into fragments (Forman & Godron, 1986). Then, the most connected element than any other in the landscape is identified as the matrix. If the results are still not definitive, the studied element must be analysed through the degree of control it has over landscape dynamics. This last criterion is the most difficult to assess since it requires field measurements or published data on species to achieve a precise result.

Heterogeneity

The matrix always presents a degree of heterogeneity. This aspect can diffuse the distinctions between matrix and patches since any part that diverges from the matrix could be excluded from it (Forman & Godron, 1986). Since no object is completely homogeneous, deciding the fineness or resolution is crucial to observing a landscape that can be perceived as homogenous if the landscape elements from which it is composed do not vary significantly throughout.

Porosity

Porosity is the measure of the density of patches in a landscape defined by the number of closed boundaries included within a unit area of a matrix (Forman & Godron, 1986). Closed boundary elements do not touch the perimeter of the space or studied landscape, while open boundary elements' ends intersect the boundaries of the area of study. The more

closed boundary components present in a matrix regardless of size, the more porous it is. As stated by Forman and Godron (1986), this measurement is relevant as it reflects the degree of species isolation and genetic variability within populations of flora and fauna in a landscape, and the index of the amount of edge effect present, which has an impact on wildlife management, and energy, material, and species flows.

Mosaics and overall structure

From an aeroplane, land almost always appears as a mosaic. The glorious mosaics of St. Mark's in Venice or the University of Mexico appear as a pattern of coloured patches and strips, usually with a background matrix.

Richard T.T. Forman (1996)

Land mosaics are at a *human scale* and measure hundreds to thousands of kilometres. As land is always heterogeneous, it has a structure and it presents in two ways: a gradient, which is gradual variation over space in the objects present and has no boundaries, patches or corridors; or through a mosaic, where objects reunite and form visible boundaries. The patterns present in the land mosaic are due to three mechanisms. The first is substrate heterogeneity, such as topographically important elements and soil types, that creates vegetation patchiness; natural disturbance, like natural disasters, that form heterogeneity; and human activity, which results in the composing elements of the mosaic (Forman, 1996).

The landscape's general structure can be transformed by certain processes that increase habitat loss and isolation and impact spatial patterns and ecological processes differently.

Perforation is the process of making holes in an object such as a habitat or land type. Dissection is the carving up or subdividing of an area using equal-width lines. Fragmentation is the breaking of an object into pieces (that are often widely and unevenly separated). Shrinkage is the decrease in size of objects, and attrition is their disappearance.

Richard T.T. Forman (1995)

The processes chronologically listed above affect all of the aforementioned landscape elements. Although fragmentation is one of the most known changes in the landscape, it is but a phase of a greater sequence of landscape transformations. Each spatial process has a particular effect on spatial patterns and ecological processes (Forman, 1995).

As stated by Forman, Dramstad and Olson (1996), the structural and functional

integrity of a landscape is understood and studied through its pattern and scale. The following concepts are directly related to the latter and will provide an overall view of the landscape's structure and functioning.

Networks

Networks are mostly formed from interconnecting corridors with the characteristics explained previously. Nonetheless, matrices can also form networks when enclosed landscape elements are large or highly porous and turn into interconnected strands. Man-made linear elements can also link and result in networks (Forman & Godron, 1986). They develop patterns, such as the reticule which consists of linear features that connect and contain loops, providing alternate pathways to species moving along them. Movement efficiency is vastly due to diversity in routes or loops in a network, which decreases the negative effects of gaps, disturbances and some dynamics (Dramstad et al., 1996). Among other existing patterns, we find polygonal, hexagonal or irregular paths.

Networks present the same irregularities as corridors: breaks and nodes. Both happen where lines converge, end in a cross, T, or L shape, or are connected with patches. Nodes appear where intersections occur, creating spots wider than the corridors but too small to be considered separate landscape elements (Forman & Godron, 1986). In intersections, interior and edge species distributions differ, since the richness of interior species increases due to the intersection effect, that is, a change in ecological conditions resulting in microclimates.

Every network has a mesh size, which is the average distance between lines, or the average area of the elements enclosed by the grid (Forman & Godron, 1986). This measure is directly related to the grain size of a species, known as the distance or space used by one species to perform the necessary functions for its survival. Other important factors of network structure are the historical, economic, social and ecological factors that have led to its current state.

Grain size, scale and landscape heterogeneity

The scale of the cartography or visual representations used to examine a landscape is of great importance. Forman and Godron decided to do a categorisation of two main scales: fine and broad or coarse. A coarse-scale area has mainly large patches and supports specialisation but requires extensive energy to cross and access diverse resources. Differently, a fine-grain zone is a mixture of different smaller habitats and eliminates specialisation,

favouring generalist species (Forman, 2016). Both with their respective resolution or ability to detect small objects (Forman & Godron, 1986). Coarse-grained landscapes provide areas for aquifer protection and specialist interior species, while fine-grained landscapes have mostly generalist species. All landscapes are either fine or coarse-grained depending on the size of their elements which can be determined by measuring the average diameter or area of the landscape elements present and by estimating the variation in sizes. To provide the landscape with the benefits of both types, a coarse-grain region with fine-grain areas is the ideal design (Forman, 2016). The landscape grain size is different from the species grain size.

Landscapes have a structure that can be understood in different scales. As a whole, the structure is a true synthesis possessing properties that its parts lack. The configuration of the landscape elements can be of either microheterogeneity or macroheterogeneity. The first one is characterised by an assemblage of similar element types around a point no matter its location. On the other hand, macroheterogeneity is the assemblage of landscape element types that differ greatly in portions of the observed area. In this case, the environmental gradient is constant and causes a continuous change or continuum of flora and fauna (Forman & Godron, 1986).

Even though some of these concepts require quantitative measurements, urban planners and designers can begin to form a critical vision of a landscape beyond a medium or micro scale normally involved in design. Recognition of the landscape as a whole, rather than just its components, is crucial for proper project conception.





Map 02: landscape ecology principles in regional scale - agroecological network of Nyon Région and La Frontière

- Water bodies
- Open watercourses
- Underground watercourses
- Agricultural lands
- Forested or woody lands
- Development
- Road system

Notes

About watercourses

As the previous map, the waterways come from a survey for the *Projet d'Agglomération de Grand Genève*. The layers contained piped watercourses, groundwater flows, underwater bodies and others not identified, all the mentioned above were grouped in the *Underground watercourses* layer, as a difference did not need to be made.

About development and agricultural lands in France

The information used to create the layer was retrieved from general metadata of the allotment distribution in France, since the specific information of the usage was not found, the differentiation was made from a satellite photography survey via Google Maps and the *Géoportail* of France. Hence, the information is not completely reliable once the border to France is crossed.

About representation

In the same spirit as Map 01, the method of representation chosen was inspired by the diagrammatic maps found in the book *Landscape ecology principles in landscape architecture and land-use planning* by Wenche E. Dramstad, James D. Olson and Richard T.T. Forman.

About scale

The frame of this map was chosen to portray the landscape according to two agroecological regions: Nyon Région and La Frontière, to show the most important watercourses of the area connecting to the Léman, and to display important woody or forested patches.

Remarks

Through this theory, the most marking elements of the landscape mosaic are identified. The contrast between the elements is high, as there are significant differences in habitat typologies. As it becomes clearer, this portrayal corresponds to a coarse-grain vision, as subtler particularities of the patches are disregarded.

Map 02 presents most of the concepts mentioned above. Patches are found in the form of environmental resource patches in *Forested or woody lands*, and as introduced patches in *Development*. Corridors are present in linear and stream form, usually together in *Forested or woody lands* and *Open and underground watercourses*, and as the *road system*. Stepping stones are visible, for example, towards the end of the Asse stream. Lastly, the matrix is clearly identifiable, being represented by the *Agricultural lands*.



0 km



+3



Écologie du paysage

Then landscape ecology had a lasting renaissance.

Jacques Baudry (2019)

At first, hearing the name *écologie du paysage* could seem like a translation from landscape ecology to French. It is, however, more than just a change of language. Shortly after the birth of landscape ecology often owed to Richard Forman, a new viewpoint on landscape ecology was being forged on the other side of the world: France. This further step in ecology understanding aimed to analyse not only those typically conceived as *natural* spatial patterns, but also what is in between them, and their role in a complex and dynamic mosaic in constant connection with man-made and man-transformed areas.

The *écologie du paysage* considers humans an integral part of ecosystems forming the biosphere. Man is, therefore, considered an invasive species capable of adapting to all types of environments by destroying, modifying, transforming, and even creating entirely new ecosystems. This new perspective changed how ecology understood ecosystems' structure, organisation, functioning and evolution (Burel & Baudry, 1999).

This discipline was developed within the landscape ecology bases created by Richard Forman and Michel Godron considering all the elements composing the landscape: matrix, patch, corridor, network, and mosaic, among others; not without questioning and proposing two arguments. The first point made was about the visual predominance of the elements. These are visual entities that are mid-term permanent and not functional, as they ignore nonvisible differences that are not represented in the original proposed components of the landscape. The second argument questioned the idea of the matrix as an indistinct hostile or neutral space. In land-based environments, there is always an overlooked gradient (Burel & Baudry, 1999).

Origin and definition

The definition of this discipline was based on the concepts first conceived by Georges Bertrand in 1975 and the ones given by Richard Forman and Michel Godron in 1986. Jacques Baudry and Françoise Burel developed in 1999 a new perspective of landscape



ecology. The *écologie du paysage* aimed to fusion the definitions of the authors above. It refers to a level of organisation of ecological systems going beyond the ecosystem, and it is characterised by heterogeneity and the dynamics resulting from human activity (Burel & Baudry, 1999). The landscape then transcends big physical figures, since its dynamic is thought to be independent of visual perception.

This theory defines landscape as an object of study, environment and society as key influences, and integrates them with their effects on the studied ecological processes. Therefore, the definition of spatial elements forming landscape structures, shared with other disciplines, is a crucial step in any research (Burel & Baudry, 1999). This approach changed how the matrix was conceived. With an important focus on farmlands, they become a key player in the landscape dynamic capable of connecting or blocking movements, and even becoming a potential habitat for periods. Agricultural lands mould the landscape and the quality of the habitats, and therefore affect biodiversity (Burel & Baudry, 1999).

The landscape's structure and its dynamics are not only defined by the history and evolution of societies but also by its ecological organisation, its heterogeneity, and its diversity. The flux of organisms or nutriments, the spatial repartition of species, and the spatiotemporal structure play a vital role in the ecological organisation, which are interpreted by ecologists. Hence, the *écologie du paysage* is a medium to translate spatial structures into spatial relationships, allowing predictions of effects in the functioning of the landscape (Burel & Baudry, 1999).

Scope, range and scales

Both *écologie du paysage* and landscape ecology rely on a set of spatial structures that define and help interpret its ecologic dynamics. These structures can be applied on a wide range of scales, from continents to micro-sites. Nonetheless, the areas of study are chosen by the prevalence of human activities and the scale of human perception. Therefore, this excludes the regional, continental, and local scales. If the landscape is defined as a space where human activities exist, the range of scales is reduced from hectares to hundreds of square kilometres (Burel & Baudry, 1999).

Main principles

This approach was born from the need to answer questions regarding nature conservation facing an ever-changing landscape that becomes harsher and harsher. Multidisciplinarity was indispensable. To understand various phenomena, the discipline had to undergo several changes: to explicitly take space into account, to recognise man as a decisive part of the ecological system, and to see spatial and temporal heterogeneity in the studied environments (Burel & Baudry, 1999).

Heterogeneity of Ecological Systems

(...) l'ensemble de taches, corridors et matrices constituent ainsi une mosaïque hétérogène qui peut se définir par la diversité de ses éléments et par la complexité de son organisation.

Philippe Clergeau (2007)

Heterogeneity is defined as the essential principle of the discipline through which it is possible to identify the landscape elements, such as the matrix, patches and corridors (Godron & Joly, 2008). This aspect is reliant on the complexity of the composing elements of the landscape and the scale of perception of the observer (Clergeau, 2007). The landscape representation will be done by identifying the elements forming the territory mosaic and their spatial arrangement, but it will adjust depending on the diversity of the elements present in a given area and the perception of the author or phenomenon studied.

Additionally, heterogeneity influences the organisation of communities. Each group of species has a level of tolerance towards external forces that create spatial distribution gradients forming units. The composition of these units is defined in function to the responses of each individual to present or past biotic or abiotic conditions (Burel & Baudry, 1999). All ecological systems, heavily affected by human interventions or not, are dynamic. The origins of the dynamic are called disturbances. These conditions, as mentioned above, can be abiotic, biotic or man-caused. Changes such as farmland expansion, forestry exploitation or urbanisation are the main transformations causing landscape dynamics.

The heterogeneity perceived in a given moment is the result of spatiotemporal heterogeneity, environmental constraints, ecological processes, and natural or anthropogenic dis-

Translation to English: "(...) the array of patches, corridors and matrices make up a heterogeneous mosaic that can be defined by the diversity of its elements and the complexity of its organisation."



Nyon, Clinique la Metairie © Swissair Photo AG, 1987

Picture showing an interesting level of heterogeneity. Elements like woodland patches, ecological corridors, farmland of diverse crops, among others are visible in the landscape mosaic.

turbances (Burel & Baudry, 1999). It is not only revealing of current conditions but also of history. The presence of certain species or the lack of others are outcomes of a phenomenon that might not be visible anymore (Clergeau, 2007).

As explained later on, farmlands used to be considered mostly as part of the matrices in most cases. Cultivated lands are nonetheless part of the landscape mosaic, a provider of heterogeneity to the territory. The disturbances related to these typologies are linked to farming mechanisms, such as land-use allocation and crop succession, which explain the biodiversity status of an area (Baudry et al., 2000). These constant changes imply a certain functioning that may or may not correspond to the visually evident structure of the landscape.



Vüe de Nyon © The Swiss Art Research Infrastructure, Carl Hackert, 1782

Artwork showing a view of Nyon from the Boiron. It shows the influence of human doing in urban traces still present, as well as economic activities.



1260 Nyon, 46°23'53.9"N 6°12'55.9"E

Photo taken during one promenade on-site. The area was being laboured, showing a special diversity of farming crops, most of them non-active or being prepared for future cultivation.

Influence of human activities in ecological systems

Il fallait donc passer de l'approche naturaliste à une écologie intégrée, c'est-à-dire à une prise de compte d'une autre échelle de fonctionnement biologique que celui des individus au sein des populations animales ou végétales. Il fallait en même temps intégrer les activités humaines qui sont une composante majeure des comportements des espèces et du fonctionnement de leurs habitats.

Philippe Clergeau (2007)

The concept of landscape has undergone a significant transformation with the advent of Baudry and Burel's contributions. Earlier, scholars considered landscapes homogeneous natural environments, devoid of almost any or low human influence. Human activities were primarily confined to woodland areas, related to deforestation and urbanisation, which are relatively slow processes. Agricultural lands were excluded from the landscape mosaic, as they undergo rapid changes.

The conception of landscape not only evolved through heterogeneity but also by understanding that human activity dynamics play a significant role in the emergence of environmental problems. The landscape is the result of a constant confrontation between society and its setting (Burel & Baudry, 1999). The landscape is the survivor of natural and anthropogenic disturbances, which are not static, but ever-evolving. Modern society, as fast as it is, will change, adapt, and affect the surrounding natural or man-made environments.

The current landscape's structure is the consequence of the interactions between society and the environment where it settled. These are contributors to modern environmental issues, which nowadays have worsened because of demographical growth, industrialisation, and technological advancements. Human actions influence landscapes and the planet's ecosystems directly through resource exploitation, farmland and urbanisation expansion, or indirectly through climate change or industrial pollution (Burel & Baudry, 1999). Urban growth threatens the survival of local and regional biodiversity (Clergeau, 2007). Human impact has to be analysed in all sorts of spaces, from the purest to the most anthropized. The understanding of ecological functioning can only be achieved by establishing a link between human activities and ecological processes (Baudry et al., 2000).

Translation to English: "It was therefore necessary to move from a naturalistic approach to an integrated ecology, i.e., to take account of a biological functioning scale other than that of individuals within animal or plant populations. At the same time, we had to integrate human activities, which are a major component of species' behaviour and the functioning of their habitats."

Space and time

Landscapes are dynamic and to understand how a dynamic system functions, it needs to be placed in space, in particular by studying exchanges between neighbouring systems, and in time, because the status of a system is highly dependent on its dynamics and of its initial condition (Burel & Baudry, 1999). Ecological systems are to be represented explicitly, this is, they should be described with the amount of detail and information needed to understand how a process interacts in the area of study. The visual representation of the functioning of a landscape is one of the best responses to understanding the ecological processes at a landscape level.

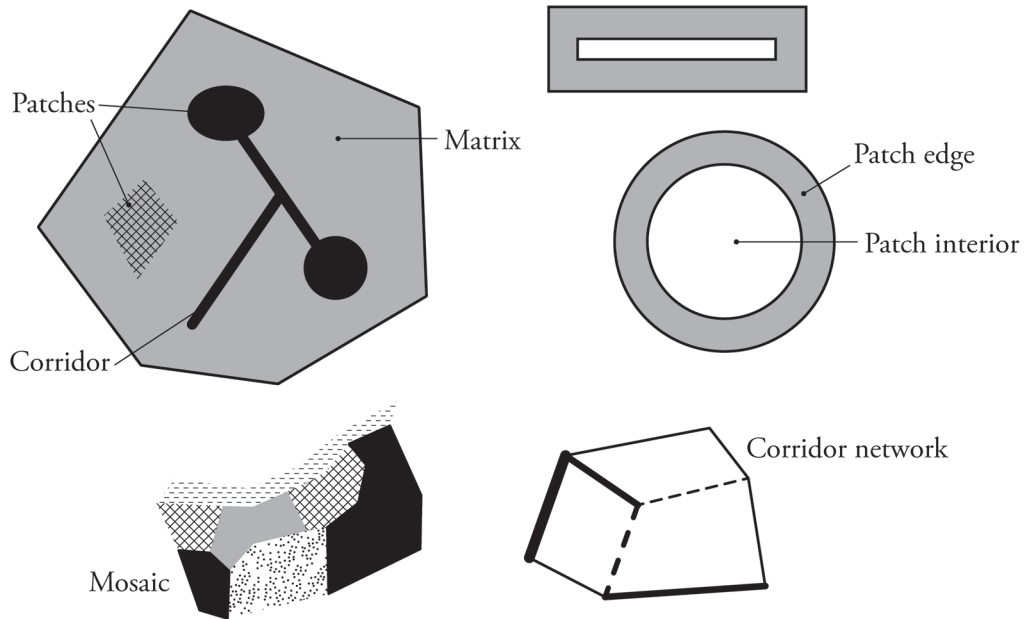
Time is also a key factor to take into consideration when deciphering a territory and understanding its evolution mechanisms. The organisation of animal or vegetal communities and matter and energy cycles are not only dependent on current environmental conditions but also on recent or past history (Burel & Baudry, 1999). The present status of an area of study is also the result of previous disturbances and land-use modifications that result in the characteristics, limitations, and potentials of a site.

Bases on ecology scientific theories and neighbouring disciplines

Like other disciplines, *écologie du paysage* was born based on previous theories and works of ecology, but it surpassed the threshold of ecology and reached other fields of study. Human sciences entered the picture once human activities were recognised as key forces of landscape dynamics.

Some of the main theories on which the work of this discipline is based are the theory of hierarchy by Allen and Starr in 1982, the theory of chaos by Gleick in 1991, the fractal geometry of Mandelbrot in 1984, and the theory of percolation to understand complex systems. Regarding spatial and temporal ecological system analysis, the biogeographical theory of islands by Mac Arthur and Wilson in 1967 and the theory of disturbances by Pickett and White in 1985 were used (Burel & Baudry, 1999).

This work will not focus on understanding these concepts but will understand the reflection behind the cartographic representation of the landscape from the lens of *écologie du paysage*. However, the definitions of these theories will be found in the glossary.



Landscape elements categories (Redrawn from diagram *Les catégories d'éléments du paysage* © Yannic Le Flem, 1999)

Spatial structures

As aforementioned, the interpretation of landscape ecology proposed by Jacques Baudry and Françoise Burel is based on the elements found in a landscape initially proposed by Richard Forman in 1981. Thus, both approaches share the understanding of the matrix, dominant and encompassing element inside which we can find patches, such as woodlands, copses, or habitats; and corridors, which are linear elements. A group of patches forms a mosaic, and a group of corridors makes up a network. A patch will be formed by an edge and an interior, and the spatial arrangement of the mosaic and networks is a landscape pattern (Burel & Baudry, 1999).

However, several questions were raised regarding the visual predominance of these elements. There is no doubt about the presence of them in a landscape, but their existence is not imperative to specific dynamics. Several factors are neglected if the understanding of these figures stays visual and not functional, which in several cases refers to invisible changes or conditions.

On the other hand, landscape ecology treats the matrix as a hostile or indifferent area, almost excluded from the dynamic. The landscape is a gradient of conditions, the reason why Baudry and Burel prefer the term *landscape mosaic*, referring to the overall continuous ensemble of differently-natured patches (Burel & Baudry, 1999).

The coming spatial structures or concepts will be described with the help of images taken on different areas of Nyon and iconography retrieved from authors using the same interpretation of landscape ecology. The cartographic representation provided will help exemplify the elements in an area of study: Nyon. The objective, just as in the case of landscape ecology, will be to create a general understanding of the theory through definitions in written form, complemented with photography of the elements in reality and an example of possible cartographic representation.

This compilation of spatial structures will be by no means an extensive and in-depth description of the palette used by ecologists since many of them require the knowledge experts in the field have studied years for. Nevertheless, the goal is to understand some of the most important conceptions capable of changing our comprehension of the landscape.

Landscape mosaic

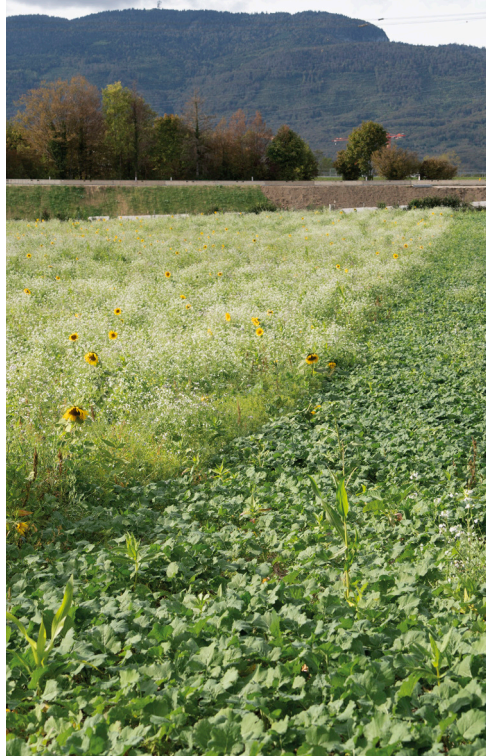
Heterogeneity

Un paysage se présente d'abord comme un ensemble de types d'éléments plus ou moins fragmentés ou connectés : c'est la mosaïque paysagère que l'on reconnaît comme un ensemble spatialement hétérogène.

François Burel and Jacques Baudry (1999)

Heterogeneity can be defined through two main components: element or patch diversity and the complexity of the spatial relationships. The heterogeneity can increase because of a change of proportion and number of elements, by diversifying the types of elements composing the mosaic or by the complexification of the spatial arrangements between elements, which can be simultaneous to fragmentation. Thus, the variety indicates the number of elements present, the diversity shows the proportion according to the surface available and heterogeneity is the medium for understanding the spatial relationships (Burel & Baudry, 1999).

Translation to English: "A landscape is first and foremost a set of more or less fragmented or connected types of elements: this is the landscape mosaic that we recognise as a spatially heterogeneous entity."

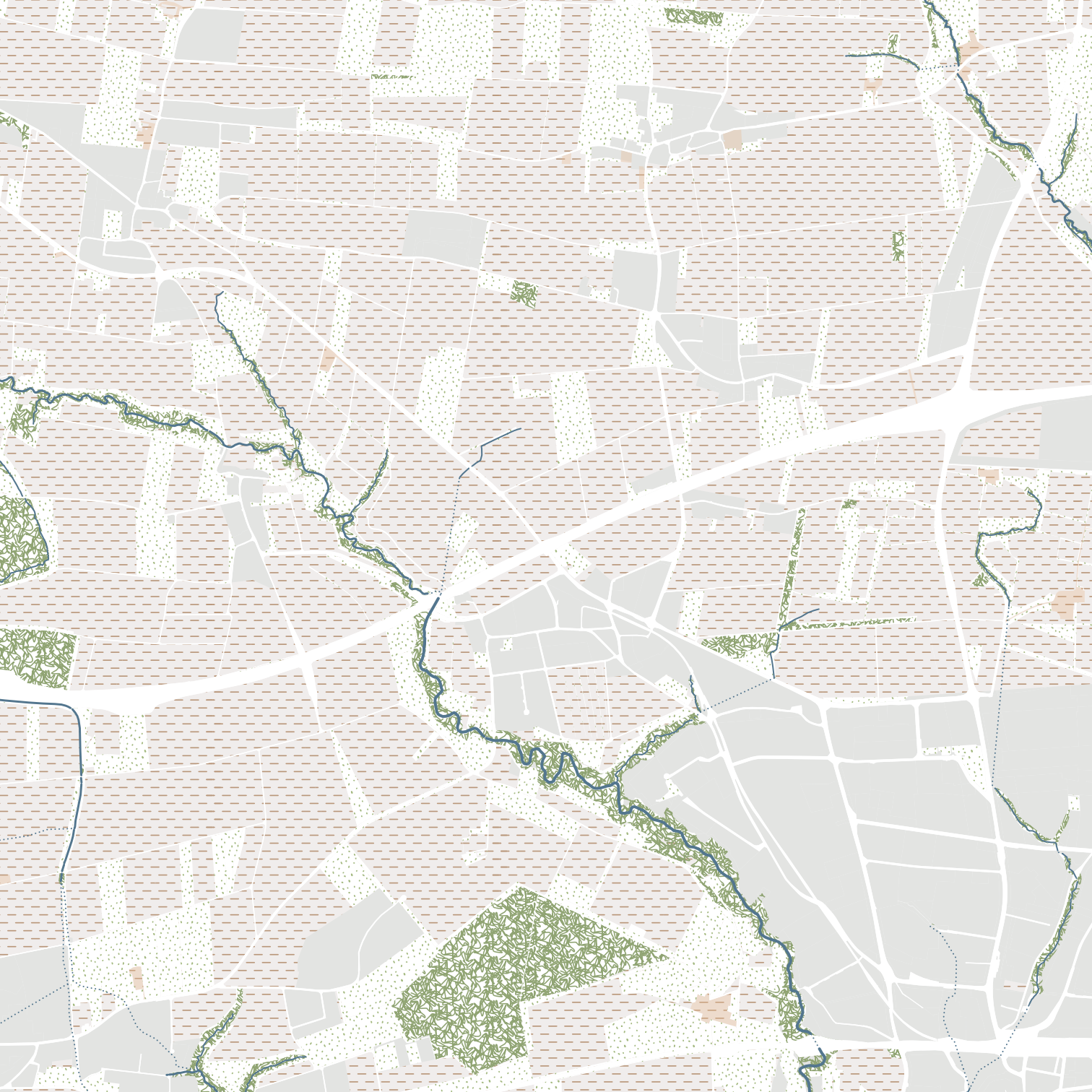


1260 Nyon - 46°23'50.0"N 6°12'59.8"E

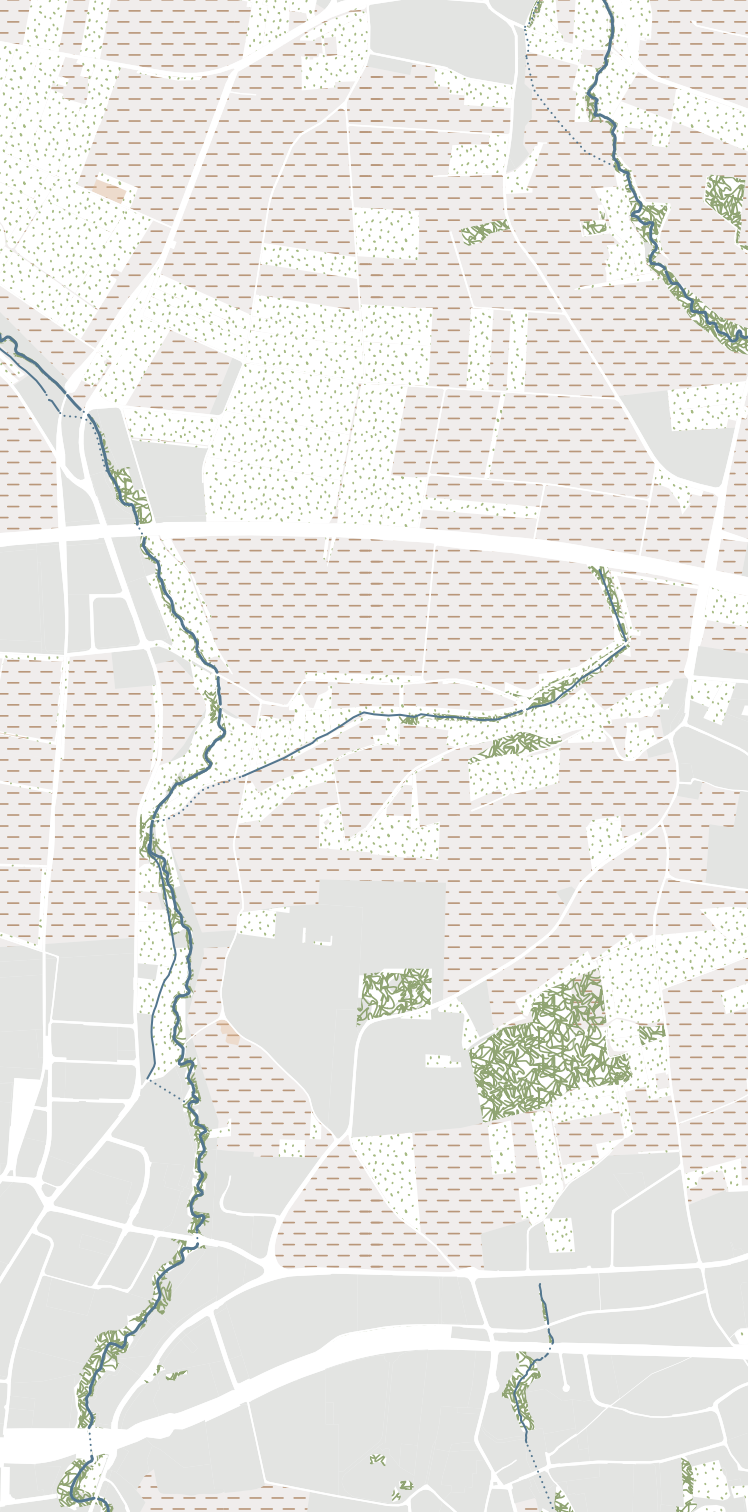
An heterogeneous landscape: different typologies of crops interacting with each other. Some fields had active temporary meadows, others had active corn crops and others variable vegetation.

Landscape elements have characteristics and provide certain conditions that differentiate them from others that visually might look homogeneous. The cartographic representation of a landscape can be done in layers of information that can go from basic concepts to more detailed ones. Creating a difference between built and natural areas is not enough. Detailed typologies of a certain type of patch or corridor are proposed to further understand the organism or functional group of organisms to be studied. Coherence in studied typologies should be assured, in space and time to be able to do the pertinent comparisons.

The typological gradients provide more information about one element, adding the detail necessary to address specific questions of ecological dynamics or a group of species in particular. The cartography responds to questions or particular points of view, which are necessary to define before the production of any visual representation.



Map 03: typologies of landscape units - coarse-grained



- Water bodies
- Open watercourses
- Underground watercourses
- Woodlands
- Towns
- Crops
- Abandoned fields
- Pastures

Notes

About watercourses

The waterways were retrieved from a survey for the *Projet d'Agglomération of Grand Genève*. The layers contained piped watercourses, groundwater flows, underwater bodies and others not identified. All of the mentioned above were grouped in the *Underground watercourses* layer.

About representation

The layers to be represented were chosen and inspired by the paper *Scale dependence of spatial patterns and cartography on the detection of the landscape change: relationships with species' perception* by Susana Suárez-Seoane and Jacques Baudry in 2002. In their work, they take into consideration a gradient of typologies which go from the coarsest to the finest-grained species' vision. A similar exercise was done adapted to the available information and the landscape of the case study.

About scale

The frame and scale were chosen to visualise an adequate portion of the two main open watercourses of Nyon and the agricultural plots in the periphery of the city's main settlement. At the same time, they were selected to meet the visibility needs of the maps that share the same perimeter.

Remarks

This map shows the studied landscape as a mostly heterogeneous mosaic with three main typologies: built habitats, farmlands and pastures. The fourth typology, woody or forested lands, are mostly found in the same areas as the principal open watercourses.

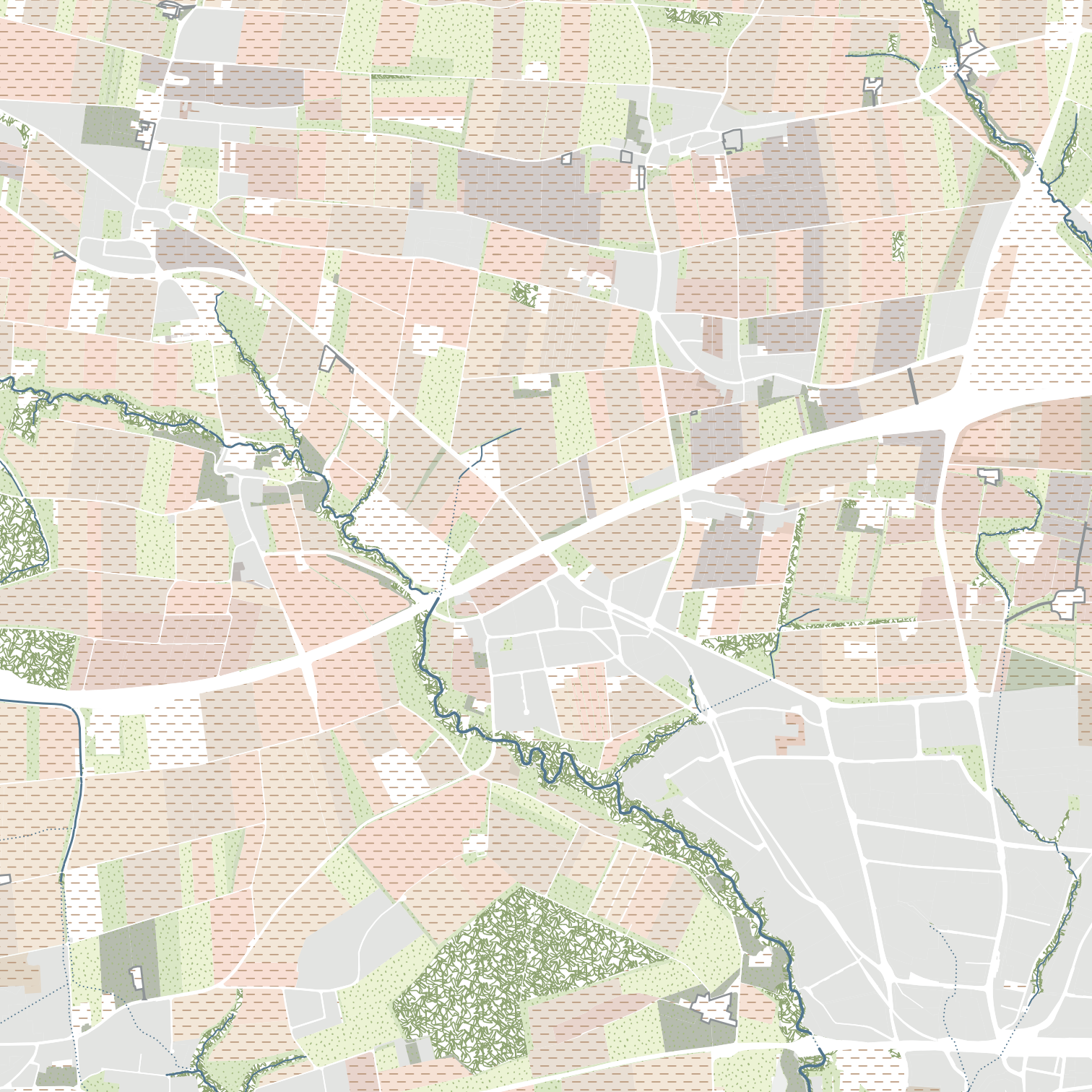
The “borders” between built and vegetation areas are quite harsh, showing low variability and typology gradient. Densely vegetation areas are scarce and are almost non-existent in the agricultural zones, hence, bocage-type elements are absent.

There are important infrastructural linear elements that section the ecological corridors, separating the woody and forested zones and piping the watercourses of the landscape.

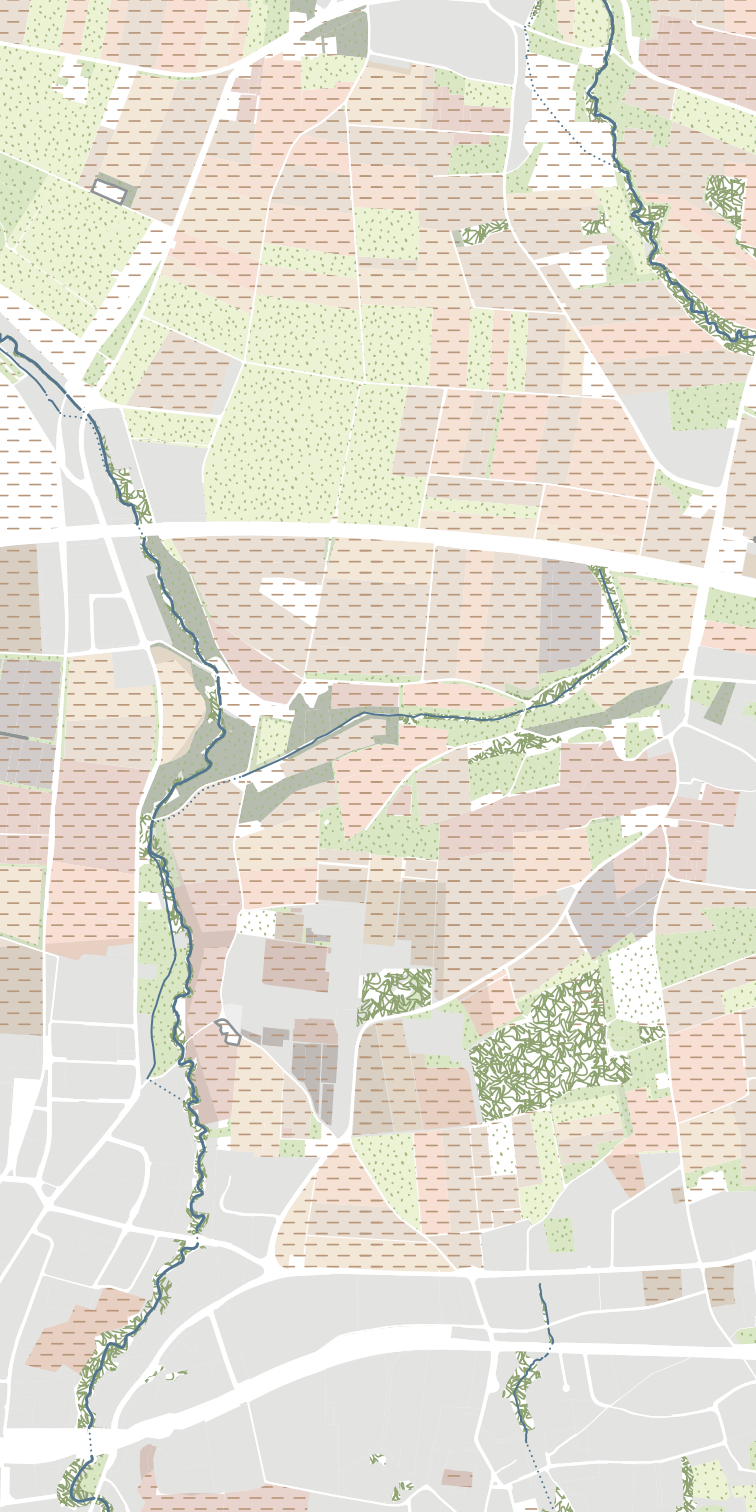


0 km

+1



Map 04: typologies of landscape units - fine-grained



- Water bodies
- Open watercourses
- Underground watercourses
- Woodlands
- Towns
- Crops**
- Arboriculture and fruit cultivation
- Cereals and pseudo-cereals
- Legumes and vegetables
- Corn
- Oil-producing farming
- Wine-producing farming
- Others
- Abandoned fields
- Pastures**
- Temporary meadows
- Permanent meadows
- Hedgerows and cultivated strips
- Fallow lands
- Pastures
- Others

Notes

The same notes of the previous map apply to Map 04.

Remarks

In comparison to the previous map, there is a visibly more heterogeneous landscape mosaic once farmlands and pasture typologies are more defined. Yet, there is a clear predominance of corn and cereal cultivation against other crops or pastures.

Due to the extension of temporary and permanent meadows, there is a slight growth in the width of the stream corridors present as a gradient of forested or woody to meadow-type habitats.

Still, the borders between farmlands and pastures, and the built zones remain rigid. The infrastructures are present as important ruptures and barriers of the whole landscape mosaic.



0 km +1

Scale and hierarchy

Scale and hierarchy play a key role, especially in the cartographical representation of spaces in space. The scales of space and time are related to the way species use their habitats. Normally, closed-up areas hold great detail and are used to represent species travelling slowly, whereas bigger zones with less detail show species that move rapidly and within greater distances. When space and time are taken into consideration simultaneously, it results in a correlation between spatial and temporal scales (Burel & Baudry, 1999). This shows how a landscape is organised and also the evolution of species movement or a phenomenon. Individuals respond to environments in different spatial and temporal scales. The scale at which behavioural relationships between landscape structure and habitat selection operate is species-dependent (Suárez-Seoane & Baudry, 2002). For species of high mobility or multi-habitat, a *coarse-grained* categorisation of typologies is sufficient. On the contrary, for species with limited movement capacity or specific habitat preferences, a more detailed or *fine-grained* categorisation of typologies is needed.

The information of spatial resolution is correlated to time. When fine detail is provided and the time lapse is limited, it describes a fast phenomenon that happens in reduced areas. In cases where the detail and time are average, the behaviours displayed are of species movement in wider areas of hectares and through several years. Finally, when the detail is minimal and the time is elevated, the phenomenon shown is in regional scales and through decades. Each species has its scale of space and time depending as well on how they perceive the landscape, and they have a place in the hierarchy of the whole ecological system.

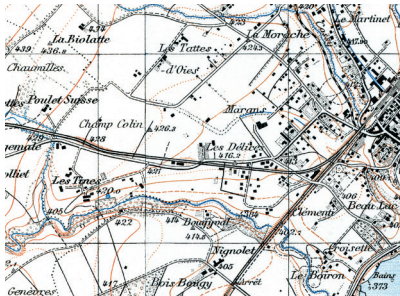
Fragmentation

La fragmentation peut jouer un rôle essentiel dans le maintien des populations ; il peut y avoir suffisamment d'espace pour un ou quelques individus, mais pas pour une population.

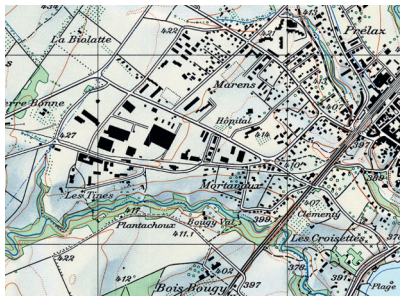
François Burel and Jacques Baudry (1999)

Fragmentation is a spatial concept at its core but can also be extrapolated from habitats to populations. It not only affects habitat sizing and the edge effect but also its internal heterogeneity. Areas can get colonised by external forces and therefore get diversified.

Translation to English: "Fragmentation can play an essential role in maintaining populations; there may be enough space for one or a few individuals, but not for a population."



1954



1977



2000



2023



- | | | | |
|--|----------------------------|--|---------------------------|
| | Waterways and water bodies | | Lands of dense vegetation |
| | Open watercourses | | Farmlands |
| | Underground watercourses | | Urban settlement |

According to Burel and Baudry (1999), there are parameters through which fragmentation can be analysed. The first one is by observing a constant decrease in the total surface of the habitat; next, the increased number of patches while experiencing a decrease on the surface; the perimeter of contact of patches increases and decreases as the surface gets reduced; connectivity declines and the distance between patches increases; and finally, heterogeneity rises until the non-habitat becomes majoritarian.

Fragmentation is a non-linear occurrence that can go hand-in-hand with linear and evident increments or reductions in varying periods and at changing paces. Fragmentation is more than a loss of habitat; it is the modification of its quality through the means of reduction of spatial connectivity, isolation, and increment of edge species (Burel & Baudry, 1999). All biological consequences due to fragmentation affect the dynamics of the concerned areas.

Ecologists use pixel resolution to represent different scales of fragmentation. The pixel size allows us to understand behaviours corresponding to fine or coarse-grain species, which view and use landscape differently. Resolution changes in maps created by experts do not imply a loss of information, but a different point of view. The grain of a species is the smallest scale in which an organism notices space changes (Burel & Baudry, 1999) and both, divergent in needs and comportment, perceive these changes as so. Fine-grain species have the advantage of surviving even in limited habitats, while coarse-grain species can be rapidly affected when a small portion of their habitat vanishes (Baudry, 2003). The grain of species also translates into their mobility range, since highly mobile species correspond to coarse grain, whereas fine grain to less mobile species. Differences perceived between fine-grain and coarse-grain species' habitats vary (Suárez-Seoane & Baudry, 2002).

Even though fragmentation is a complex phenomenon of utmost importance for the discipline, architects and urban planners can extract the logic from this understanding of the landscape to be able to halt or slow down this occurrence. By creating an overview of the zone of interest throughout time and highlighting the available habitats of the typology of choosing, we can understand the transformation of a landscape. The weaknesses or even the advantages will unfold if we look at the passing of time and care to observe the correct details hidden.

Patch size

The habitat is the ensemble of patches that organisms can use, while availability is the

quantity of habitat in a total surface or a given area (Burel & Baudry, 1999). Larger fragments may support more species than smaller ones due to their extensive habitat. Some species may be more tolerant to habitat patch size shrinkage due to their attributes, while rare ones, which tend to be more specialised in their nutrition, have shown to be particularly sensitive to a decrease in patch size (Collinge, 2009). These notions explain the scope of certain patches and their evolution in size and or of fragmented areas of study.

The sensibility of certain species also highly depends on their movement range and the scale of their activities (Burel & Baudry, 1999). Fragmentation is deeply influential in the species' survival. If a habitat is getting fragmented, the reduction of a habitat does not imply the extinction of a species in an area, but it does for a population. The diversity and richness of the area of study are then affected.

Connectivity

La capacité des individus d'une population de quitter une tache pour en coloniser une autre de même type est le processus fondamental de maintien des métapopulations. C'est également un processus essentiel de la dynamique des paysages après perturbation ou abandon des terres agricoles.

François Burel and Jacques Baudry (1999)

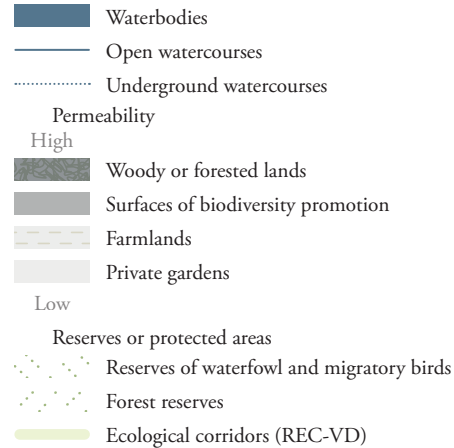
Connectivity, as described before, is one of the most widely studied concepts of landscape ecology. Not only has the interpretation of connectivity evolved in theory, but it also transformed what it could potentially look like on a cartographic level. One of the first proposed hypotheses mentioned by Baudry and Burel (1999) was that if spatial structures are influential on the regulation of ecological characteristics of a landscape, then they are correlated to same-natured elements that are connected. Connectivity then transcends the idea of linear elements and applies to all landscape elements.

Since the discovery of ecological corridor benefits, they have been widely conceived as the solving mechanism of all sorts of issues of isolated habitats and fragmentation among the scientific community. They were, nonetheless, questioned not long after. Corridors are not always the answer since they have to be evaluated in terms of effectiveness and harmfulness.

Translation to English: "The ability of individuals in a population to leave a patch to colonise another of the same type is the fundamental process for maintaining metapopulations. It is also an essential process in the dynamics of landscapes after disturbance or abandonment of agricultural land."



Map 05: connectivity through surfaces of biodiversity promotion



Notes

About permeability

A gradient was proposed to portray the connectivity through the zones protected or encouraged by authorities for biodiversity promotion. The most permeable level corresponds to *Woody or forested lands* that have prevailed and are preserved until 2023. Then, the *Surfaces of biodiversity promotion* are displayed. This includes areas such as bocages, groves, wooded banks, extensive pastures, extensive meadows, low-intensity grasslands, litter surfaces, and wine-growing areas of biodiversity of interest, among others also contemplated by the Agridea, the Swiss Ornithological Institute and the Research Institute of Organic Agriculture.

Even though the *Farmlands*, as it has been described in the theory, are connective elements, they are highly dependent on species' needs and movement capabilities. Hence, they are considered less permeable than the previous surfaces. Finally, *Private gardens* or greenery found in the city has also connective potential. Yet, as farmlands, they are dependent on the specificities of each species and are often blocked by barriers. Hence, they are considered to be the least permeable elements.

About reserves and protected areas

The forest reserves were retrieved from surveys done by the Environment Department (DGE) of the Vaud Cantonal Administration. The *Reserves of waterfowl and migratory birds* were obtained through information from the Federal Office for the Environment (OFEV). Lastly, the *Ecological corridors* show a gradient, as it shows the maximum surface extent where the highest activity is found. These are both amphibian ecological connections gathered from the Cantonal Ecological Network (REC-VD).



0 km

+2

Linear ecological corridors are the most famous spatial elements of this category. However, connectivity can materialise in different forms and have diverse effects. A corridor for a specified individual might be a barrier for other neighbouring ones. Hindering structures are vital elements of landscapes. These barriers can have negative effects, such as blocking encounters between groups of the same species; or positive impacts, like stopping the circulation of pollutants, protecting from wind, and impeding the dispersion of diseases. Such obstructions are typically corridors, like hedgerows, which protect from wind and favours fauna circulation; or riparian areas that are biological corridors and buffer zones protecting watercourses from nitrates (Burel & Baudry, 1999).

Corridor networks

As stated by Burel and Baudry (1999), corridors are organised in networks responding to specific parameters: number of connections and intersections. The number of intersections refers to the number of nodes in a network, which are the areas where different corridors converge. A more diverse and complex vegetation, a more abundant amount of habitat and richer biodiversity are usually found inside intersections. On the other hand, the number of connections alludes to the number of links between corridors in one intersection which differ depending on their configuration. There are four proposed configurations. The first, the T connection, is the link between three elements; the connection L is the joining between two elements; the X connection is the contact between four elements; and the O connection refers to a cul-de-sac.

Corridors hold distinctive characteristics and provide specific conditions and services. Hence, corridors of a similar nature can be regrouped in clusters that would result in functional networks. Even if the functional path is physically not the shortest in terms of distance, it might be the most accessible route for an individual or group of individuals.

One of the most studied and analysed linear elements in *écologie du paysage* have been grove structures, known as *bocages* in French. They are elements part of the agrarian landscape of Western Europe characterised by the enclosure of meadows and fields through hedgerows and scattered settlements (Godron & Joly, 2008). Hedgerows are not just ecological infrastructures; they also bear witness to history and culture. They are not mere structures that can be easily implemented or removed, but rather complex elements carefully managed by farmers. Since hedgerows are made up of various types of vegetation, they require different techniques and frequencies of management, which are influenced by a range



1260 Nyon - 46°22'39.7"N 6°13'41.1"E

Photography of one of the bocages encountered during one of the promenades. This hedgerow was next to an open field where no crop was active and the railways of the train that crosses through Nyon.

of factors (Burel et al., 2000). Given the focus on farmlands, *écologie du paysage* analyses the connective potential of these important landscape elements with ecological, historical, and sociological importance.

Spatial relationships and connectivity

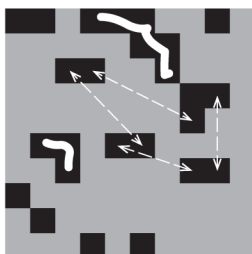
Movement between patches can happen in diverse ways, either through networks of corridors or between patches of the same or different types. Normally, mobility between different patches indicates activities such as nutrition, reproduction or hibernation, or the study of multi-habitat species (Burel & Baudry, 1999). The capacity of movement indicates two types of connectivity: spatial, and functional or biological. Spatial connectivity refers to when two patches of the same type are adjacent or joined in spaces (Burel & Baudry, 1999) and therefore species can move freely within. In contrast, functional connectivity refers to



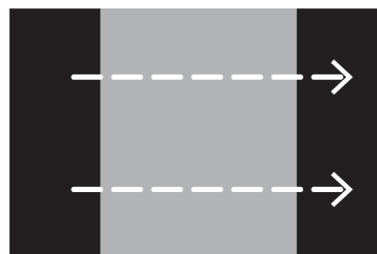
Strong spatial and functional connectivity



Average spatial connectivity and strong functional connectivity



Weak spatial and functional connectivity (mostly done through the matrix)



Non-existing spatial connectivity, functional connectivity through physical mechanism (wind)

Types of connectivity (Redrawn from diagram *Variations des connectivités spatiales et fonctionnelles* © Yannic Le Flem, 1999)

the possibility of movement of a species between patches of the same or different nature in a landscape (Clergeau, 2007). The patch location and size express several types of spatial and functional connectivity which may or may not be linked.

There are usually four typical scenarios: the first one is found when strong spatial connectivity is combined with strong functional connectivity, all movements can happen inside one continuous patch, therefore all of its parts are interconnected by animal movement. On other occasions, an area can be fragmented and yet offer paths where species will be able to cross fluently. Here, spatial connectivity is average and can be restrictive to the functional connectivity of some species which cannot move within other different elements. In other situations where fragmentation is even stronger, spatial connectivity is deeply weakened and only organisms needing limited space or whose behaviour allows movement even when spatial connectivity is poor, will be able to use these patches (Burel & Baudry, 1999). This behaviour is commonly found in birds. Finally, functional connectivity



1260 Nyon, 46°22'37.3"N 6°13'20.7"E

Example of weak spatial functionality between woody patches, but with present functional connectivity in agricultural patches used by migrating birds.

between two elements can also be assured by a physical force which allows unidirectional exchanges between two parallel elements that are not necessarily close to each other. In this case, there is no link between both types of connectivity.

Seasonality in agricultural zones

History of the land and the people determine possible patterns in the future. In agricultural landscapes, history produces field patterns, types and techniques of production, and local rules for tending the landscape.

François Burel, Jacques Baudry, Claudine Thenail and Didier Le Cœur (2000)

The matrix conceived by the landscape ecology of Forman neglected the particularities of agricultural zones since they were thought to offer poor diversity and low variability. On the contrary, these lands are variable based on crop rotation, changes in farming methods or



46°22'40.4"N 6°13'18.4"E, 46°23'46.6"N 6°12'55.9"E, 46°22'30.8"N 6°13'39.6"E

Biodiversity, what would seem a Common whitethroat (*Curruca communis*) present in low grasses close to corn crops (left), single corn stalk growing in an active temporary meadow (middle), small plot of vegetation crops between extensive agricultural areas (right).

just plant growth (Burel & Baudry, 1999) which all suggest a certain resistance, permeability, and connectivity. Agriculture was and still is a major influence on landscape dynamics.

Farming has social, technical, and ecological components and objectives which can either have negative or positive effects on biodiversity. Agricultural landscape patterns are directly determined by internal and external land use diversity. From non-cropped zones to cropped, to crop typology, to seasonality, all played a significant role in the dynamics within and offered to outside species. Diverse crops produce specific habitats, nutrition, and hiding places and offer certain permeability levels. They will vary during the year due to crop rotation and seasonality of permanent crops and therefore the use of fields will fluctuate (Baudry, 2003). The landscape is formed by operational territories of non-arbitrary structures, but their evolution is hardly predictable (Baudry et al., 2017).

As mentioned before, species perceive landscapes differently. Movement can be affected

by changes in produce and their spatial distribution within farmland rather than the actual agricultural surface. Widely spread crops of the same nature in a territory can allow favourable paths that will not directly correlate to visually perceivable landscape structures. Species reliant on cultivation surfaces depend on two main factors: the first one is the possibility of finding shelter outside during a given time or until the crop is replanted, and the second is the crop spatial organisation (Burel & Baudry, 1999).

Changes in farmlands provide conditions that are specific not only to crop typology but to the ecological patterns of a region. Even though biodiversity activity is a fluctuant phenomenon, its presence in agricultural zones goes beyond passage. It gives character to a region and repeated patterns of biodiversity if the crop systems are maintained. Cultivation is a present habitat that has to be understood, with its potential, limits, and influences on the landscape.

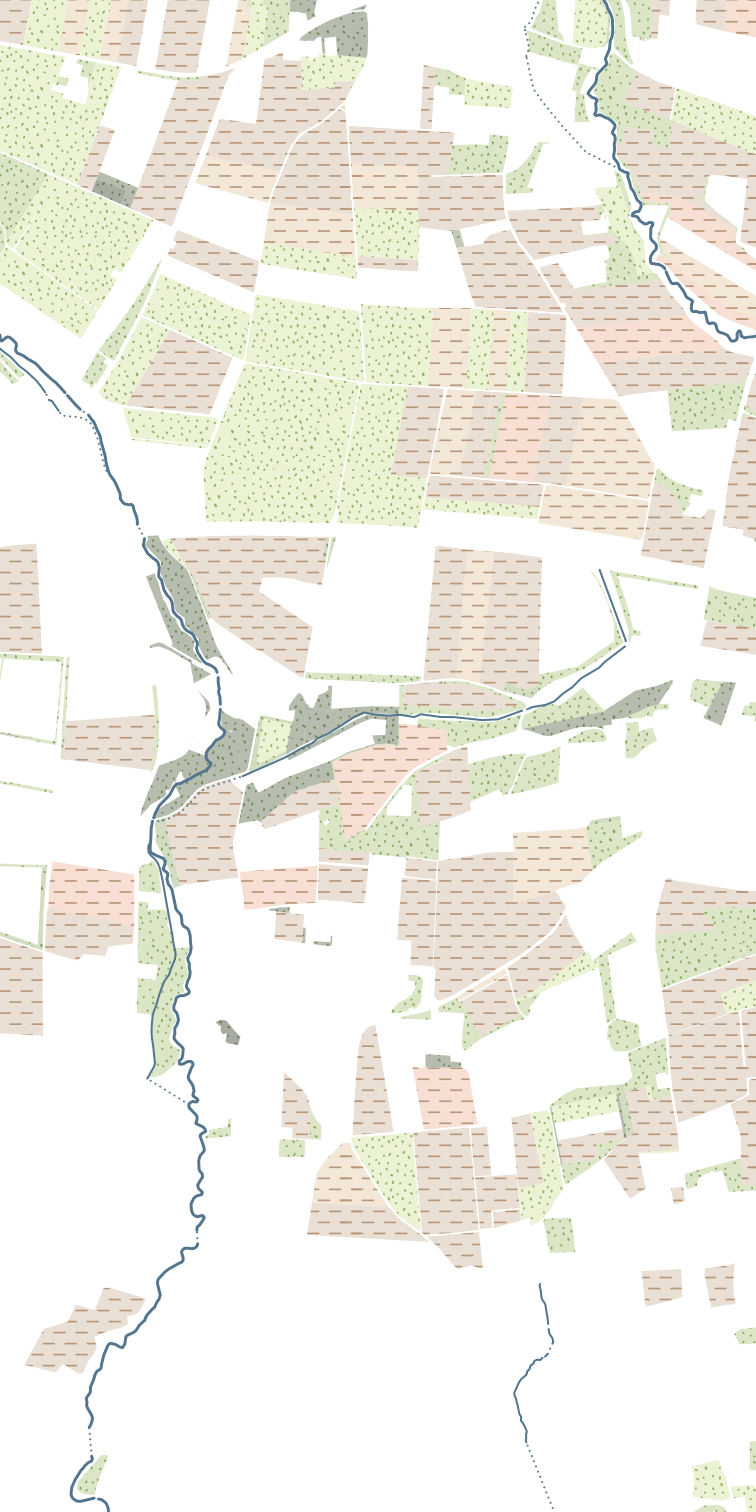
Permeability

Before, the matrix was perceived as a hostile and underused environment contrasting with specialised environments. The space in between them, often being dedicated to agriculture, is not strange to species often found in forest habitats. Corridors are the typically associated figures destined to connect, but spaces can also function as connective components. Permeability is defined as the ability of a heterogeneous area to provide passage for organisms. Beyond the identification of corridors or patches spatially connected, landscape permeability analyses the resistance to movement of organisms to decipher the potential of organisms to traverse landscapes (Triplet, 2021). The notion allows a functional understanding of the landscape since particular conditions mean particular resistances and movements.

Non-permeable elements can separate areas in proximity. Then, even when distances are limited and coarseness is strong, permeability can be weak (Burel & Baudry, 1999). Spatial connectivity is not a synonym of functional connectivity. This theory also reveals tendencies of movement of species. As in corridor networks, some individuals might prefer certain paths that present less resistance than others.



Map 06: habitat availability and typologies for Corn Bunting bird (*Emberiza calandra*)



- Waterbodies
- Open watercourses
- Underground watercourses

Farmland habitats

- Cereals and pseudo-cereals
- Corn
- Oil-producing farming

Pasture habitats

- Temporary meadows
- Permanent meadows
- Hedgerows and cultivated strips
- Fallow lands
- Pastures
- Wildlands

Notes

About sample species

The sample species was chosen from the Red List of Breeding Birds of 2021 created by the Federal Office for the Environment (OFEV) where the Corn Bunting Bird was categorised as an almost extinct species by the International Union for Conservation of Nature (IUCN). This bird is also found in the “List of species of national interest of the REC-VD (Cantonal Ecological Network)” where it is classified as vulnerable and of regional interest for preservation.

About habitats

This species prefers farmlands, wetlands and grasslands typologies. Their main habitats consist of grassy steppes, moors, grassy slopes, extensive meadows, large pastures, cereal crops, and wetland margins. They mostly avoid bogs, forests, and humus-soil areas (Donald & Evans, 1995).

Remarks

There is a habitat gap in the interior of the city. Although farmlands are not commonly found in the most anthropized zones, this suggests and rather confirms the absence of essential meadow and pasture-like habitats after their decline during the 18th century.

It is also important to highlight that while these birds are often found in wetland margins, the Asse and Boiron are surrounded by forested areas that, contrary to typical conclusions, act as a barrier rather than a corridor for this particular species. Similarly, the railways are often frequented by these birds. In this case, they perform as a linear corridor instead of an obstacle.



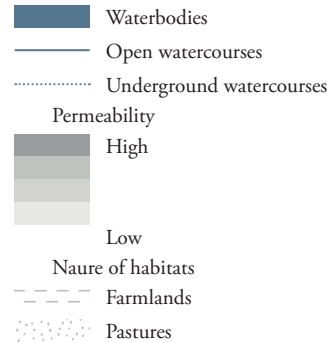
0 km



+2



Map 07: habitat permeability of the Corn Bunting bird (*Emberiza calandra*)



Notes

About permeability

A permeability gradient is proposed in response to the research done and previously mentioned about the habitat preferences of the Corn Bunting bird. The most permeable level corresponds to cereals, pseudo-cereals and oil-producing farming regarding crops, temporary and permanent meadows, and pastures. Descending the level, habitats such as corn crops, hedgerows, cultivated strips, fallow lands and wildlands were considered. The lower permeability degrees display other crops and private gardens, as they might contribute to connectivity but are less frequented by the species. Lastly, the avoided habitats and constructions are considered as the least permeable areas.

Remarks

Compared to the previous map, this view gives a broader idea of how the Corn Bunting bird perceives the landscape. It is even possible to conjecture about possible preferred routes or areas of high activity.

The landscape, in contrast to previous maps, appears as a completely different entity once seen through the eyes of other living organisms. Farmlands show the potential of becoming part of a future connective tissue of habitats.



0 km

+2

In practice

In conversation with Yves Kazémi, forestry
engineer in Vaud and professor at the
École Polytechnique Fédérale de Lausanne
(EPFL)

Today, we work through the retrieval of metadata, and it is up to us to construct a model of information organisation according to the criteria defined by theoretical models that are, for example, extracted from landscape ecology. Later, it is necessary to define how and when to intertwine the data, the result then would be an analytical model. Beyond the descriptive effort, the goal is to look for the ecological values that respond to a research question. It is when studying an urbanised area that it is important to define the spaces of high landscape, ecological and transitional value to protect them.

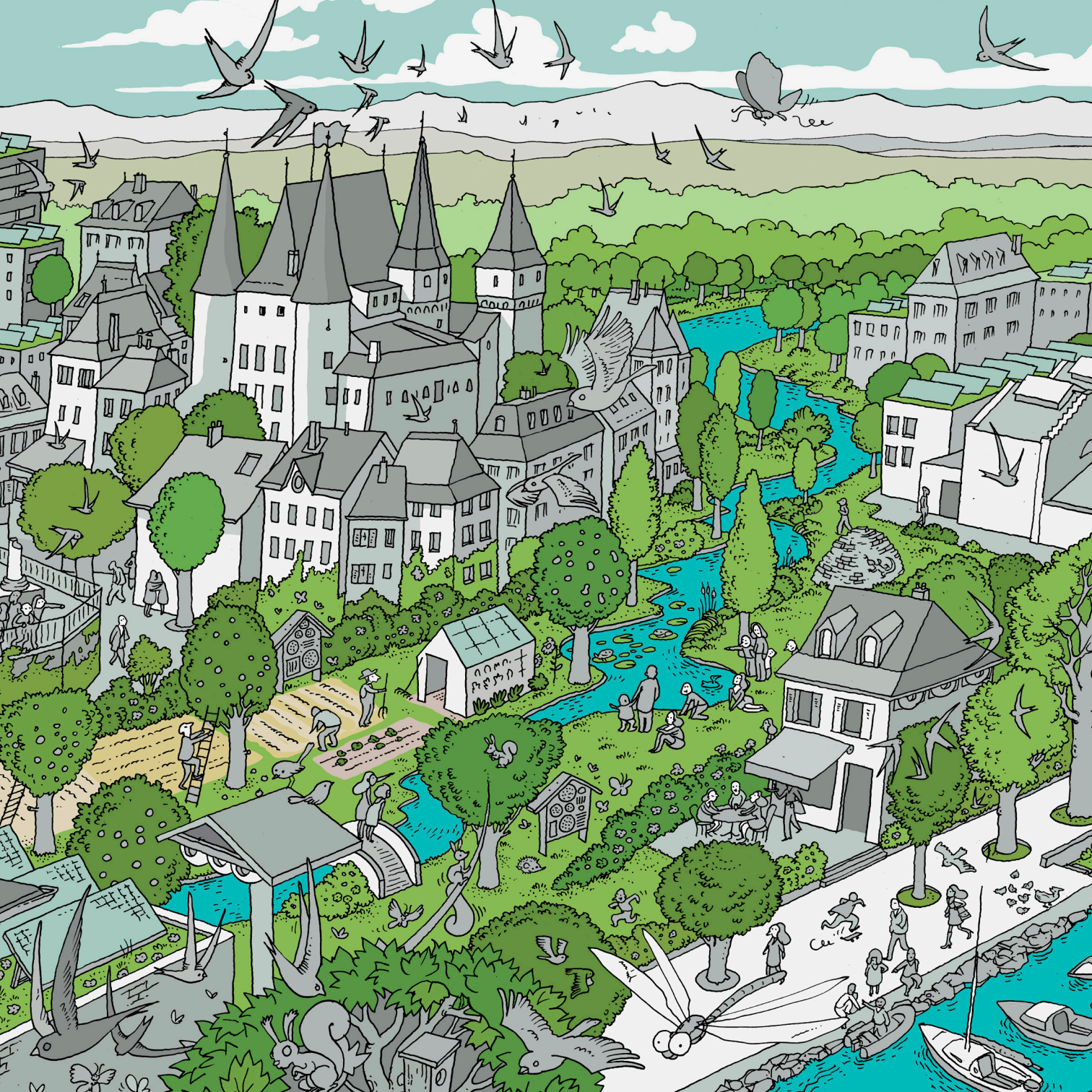
The main problem when working in a multidisciplinary medium, such as with architects, is that our fields do not share the same temporalities nor the same study surfaces. We do not work with the same scales or project processes. This is a structural issue. The city has short rhythms while the landscape has long ones.

When we speak about landscape and ecology, there are two different approaches to tackling urban planning. Once the landscape's most valuable zones are defined, negative planning would just declare which areas to conserve and leave untouched, while with positive planning it is necessary to conceive the projects in the best way possible taking all sides into account. This is why landscape ecology is so important because it highlights the most valuable ecological assets to protect and to impact the least. Naturally, all urban development will affect nature. Ideally, it is only after nature's values are defined that we should start thinking of urban development. To start planning through the definition of the unbuilt spaces and not by impact control.

There are different types of territories composing the landscape. Hotspots that should be preserved, and negotiation territories. These have interesting environmental values that need to be preserved. They can be part of development areas, but sensible planning is required. It is no longer city versus nature, but city and nature where the latter becomes an infrastructure. Urban zones can also contribute to the ecological mosaic. The idea is not to bring nature into the city but to create a green city where every system and every space will have its rules to be respected.

We need people who build bridges between ecology and urban planning. We are not expecting the decision-makers of the future city to be ecologists, but we do expect people between both worlds. That is what would change the future of the city.

09.11.2023



Landscape and ecology in urbanism

Ecological urbanism proposes (just as landscape urbanism proposed over a decade ago) to multiply the available lines of thought on the contemporary city to include environmental and ecological concepts while expanding traditional disciplinary and professional frameworks for describing those urban conditions.

Charles Waldheim (2016)

The landscape has always played an important role in our lives, especially when it comes to urban and space conception. Throughout the nineteenth century, the landscape has been defined as composed of two opposed entities: the city, represented by the high-density buildings, transportation infrastructures, revenue-producing developments, congestion, pollution, and social stress; whereas the landscape was conceived as parks, greenways, street trees, esplanades and gardens, the provider of a respite from urbanisation (Corner, 2006).

As discussed in previous chapters, the definition of landscape varies greatly depending on the domain it is viewed from. This is also true in the context of urban design. Yet, the history and evolution of urban design practices are not as linear or organised as in ecology. The upcoming chapter will not provide an all-inclusive explanation of the theories related to landscape and urbanism. Instead, it will highlight some pioneering works of authors such as Paola Viganò, and Gilles Clément, who adopt spatial conception techniques significantly influenced by the landscape beyond visual elements and modernist and pro-modernist design preconceptions.

The chapter will not focus on specific movements like landscape urbanism, landscape design, and ecological urbanism. Rather, it will discuss the general interest of experts in urban or space conception from a landscape, and occasionally, biodiversity and ecology perspective. They may or may not fall into the aforementioned categories since the discipline is constantly progressing. The description will differ from the two previous approaches but will be exemplified with iconography and pictures taken on-site for concept illustration, and cartography done based on the different theories proposed by authors.



Origin and definition

The landscape-based approach in urbanism has taken different forms and has evolved into multiple strands which all come from a mutual interest in creating a healthy ecosystem. The following evolution will introduce several currents of thought in urbanism and design that have evolved from the same objectives and principles.

In urban design specifically, the shift has been from the modernist approach of modelling cities after machines, to the postmodernist approach of emulating cities of the past, to most recently, gaining inspiration for city-building from ecology as well as information systems.

Nan Ellin (2013)

Starting in the 1990s and with the support of the emergence of landscape ecology in 1939, the landscape was broadly seen as a mosaic integrating the environment, living systems and the man-made (Shane, 2006), the problems of urban spatial organisation became more apparent with the rise of sprawling cities, gated communities, and commercial centres, which raised questions about how the city could recede into the landscape. The ecological understanding of spatial conception began its ever-evolving course that is still currently developing. The term landscape urbanism was anticipated by the organisation of the Landscape Urbanism Symposium and Exhibition of 1997 by Charles Waldheim, who had previously created a body of works supporting the disciplinary collision (Shane, 2006). Waldheim (2006) referred to landscape urbanism as a design practice that emphasized the potential of leftover void spaces in the city to be used as communal areas. This replaced traditional architectural forms as the primary medium for urban design. Landscape urbanism was an interstitial design discipline operating in the in-between spaces, infrastructural systems, and natural ecologies, improving residual zones.

In response to the growing pace at which industrial city centres were abandoned, the voids became crucial spaces of the city. James Corner catalogued this approach as performative, where spaces were *prepared grounds* capable of hosting emerging activities of social patterns that would eventually conquer them. Landscape urbanism was one of the first attempts to understand the territory beyond the built landscape. The focuses of the approaches varied from author to author, who were involved in a wide range of interdisciplinarity. The projects born during that time were mainly focused on unbuilt and marginal areas, a condition questioned by Gary Hack in 2002, who highlighted the deficiency of the

approach to adapt to complex urban morphologies.

The goal is to achieve true balance—socially, economically, and environmentally. I embrace the term “landscape urbanism,” because, finally, these two often diametrically opposed terms stand side-by-side... It [the urban landscape] can determine the health of the earth itself, establish the liveability of a city, support a city’s economy, and help to create health and happiness for its citizens. This is what ‘ecological urbanism’ can be.

Martha Schwartz (2016)

As seen in the previous citation, the path of landscape urbanism continued to evolve through time and adapted to the contemporary city. Some authors consider landscape urbanism and ecological urbanism as two different approaches, whereas others think it is a before and after, and others, as Schwartz, consider it as the same.

Mohen Mostafavi (2016) describes ecological urbanism as a design practice utilising old and new methods, tools, and techniques in a cross-disciplinary and collaborative approach towards urbanism through the lens of ecology. The author considers ecological urbanism as a critique and a continuation of landscape urbanism, which promises to develop further the discourse of the second to particular ecological, economic, and societal conditions of the contemporary city (Waldheim, 2016).

New labels of the discipline with the same spirit have emerged in recent times. Terms like integral urbanism (Ellin, 2013), which will be explored later on, materialise in the eyes of designers from the ideal of urbanism capable of answering the questions that have been left unanswered. This approach will certainly continue to change and comply with the old and new conditions of the contemporary landscape.

Scope, range and scales

Charles Waldheim (2016) states that ecological planning uses the region as the basic unit of observation and design intervention, while landscape urbanism analyses the region but reacts on a more local scale. Urban planning projects take on scales where a certain level of detail and understanding can be reached without turning into strategies or general intentions. This, of course, varies depending on the project or necessities of the mandates.

Similarly to Waldheim, Mohsen Mostafavi (2016) classifies the scale and scope of

ecological urbanism as a key characteristic. Ecology's extent is recognised to go beyond the urban territory and the city is no longer recognised as a physical artefact. Instead, the dynamic relationships between both entities go outside the limits of urban and rural terrains and ecologies. A regional *holistic* understanding is encouraged, proving the multi-scalar quality of the approach.

Main principles

The conception of landscape has gone through important changes throughout its history, especially in how it was perceived and considered by architects and urban planners. To begin, landscape urbanism is composed of four major topics: processes over time, staging of surfaces, operational or working methods and the imaginary. The first refers to the city as a dynamic space, with evolving processes and exchanges over time that pave the way for new activities and patterns of occupancy. The second theme sees working with surfaces as a choreography of elements and materials that form networks, links and opportunities over time. These opportunities are found within surface continuities. The urban surfaces may interact in diverse networks of interaction, creating areas of potential to create environments and infrastructures. The operational or working methods translate to the possibilities of conceptual, representational, and operative techniques to understand the landscape and eventually, the project. Highlighting interdisciplinarity, landscape urbanism is to be explored from different angles, perceptions, and mediums, physical and analytical (Corner, 2006).

In many ways, the failing of the twentieth-century planning can be attributed to the absolute impoverishment of the imagination concerning the optimised rationalisation of development practices and capital accumulation.

James Corner (2006)

With this statement, James Corner values the importance of creating experiences rich in the material world beyond the simplicity of *recreation* activities proposed by modernist urbanism. He considers the imaginative project to be the primary motivator of any spatial conception endeavour. Landscape urbanism was the first attempt at a discipline aware of networks beyond a functional and human-only landscape. Yet, its main topics remain vague and too general. Other authors have made the effort to specify more retrievable concepts in practice.



Jour de marché ensoleillé à Nyon © Emily Bischofberger, 1981
Photography of the Saturday market in the centre of Nyon.

Nan Ellin (2013) states in her manifesto-like proposition of integral urbanism that the urbanism of the future has no defined set of tools or perspectives but rather shared essential qualities to achieve a healthy ecosystem: hybridity, connectivity, porosity, authenticity, and vulnerability. Some of the authors' work explored further aligns with Ellin's set of characteristics and is interpreted through their different practices and scales of action. Her proposal of what urbanism should be seems to attempt the merging of some landscape ecology concepts but from an urban point of view. Hence, interpreting her notions and further understanding their scope was thought pertinent.

Hybridity and connectivity

While modern urbanism promotes the separation of functions in urban form, landscape-conscious urbanism focuses on associating functions and programs (Ellin, 2013). The integral urban design proposed by Ellin (2013) aims to create biodiversity in the urban eco-

system to enrich its health and capacity for resilience. Creating adjacencies between people and uses fosters diverse relationships and counters the modernist approach of control and separation. Instead, integration, inclusion and dynamism are the end goals.

Similarly to nature and how it has been read in *écologie du paysage*, heterogeneity is one of the main elements that highlight the values of an ecosystem. If people are perceived as part of nature, and knowing the importance of diversity, social and programmatic diversity are essential for the urban ecosystem (Ellin, 2013).

Porosity

The concept of porosity proposed by Nan Ellin treats elements found in the previously described disciplines: borders, boundaries, and edges. Nonetheless, the treatment, inspired by the non-human biodiversity dynamics, focuses on human movements and permeability. Porosity allows a diversity of people, activities, and usages to thrive along membranes to reintegrate and celebrate differences through their integrity's preservation (Ellin, 2013).

In difference to modernist and post-modernist approaches to borders, boundaries, and edges, it looks to engage and enhance differences by the (re)integration of places, people, and activities.

(...) like natural systems, urban systems must be open to receive energy and thrive, but also need membranes that function to modulate movement or flows between them and adjacent systems.

Nan Ellin (2013)

Porosity is therefore taken from the landscape ecology understanding of connectivity and reinterprets the concept for an urban setting where permeable membranes and thresholds are key regulating elements. The membranes serve as urban interfaces, which mimic ecological thresholds and are abundant in human diversity. These areas are naturally attractive due to high activity and dynamics. As such, they require precision and careful conception or modification (Ellin, 2013).

Authenticity

Authenticity translates to contextualised interventions using existing assets of a given place. Urban growth and development are guided by natural and cultural systems, relinquishing complete control (Ellin, 2013). Contrary to the popularised term by Le



Nyon © Aéroport de Lausanne, 1953

The end of the Boiron stream. Mostly privatised, this is one of the few areas where the shoreline has not yet been completely artificialized.

Corbusier: *tabula rasa*, the main focus of this *modus operandi* begins by identifying the strengths and assets of a given area. By doing so, the object of study would be valorised and later preserved, modified, enhanced, or upgraded if necessary.

The community plays a crucial role in the valorisation process of a space. Its involvement creates a meticulously crafted addition to the site of economic, social, aesthetic, and environmental value which will perfectly fit its context. Existing natural and human-crafted flows inspire this approach to urban design. They are retrieved and used as a focal point and source of inspiration (Ellin, 2013). The authenticity is shown in the capacity of integration with nature and natural processes into the built environment. The most important element for any site is its context, which provides all the necessary information and tools. According to the author, every site has unique characteristics that can be identified and utilised to their full potential. These characteristics are like hidden *jewels* (Ellin, 2013), waiting to be

discovered and utilised to fit into their surroundings with minimal environmental impact. Ignoring these characteristics is no longer an option.

Spatial concepts

The following two spatial concepts were proposed methods to read the landscape developed always under the hypothesis of the authors. In a similar line to the description of the past theories, these will have an introduction to their origins and definitions. Then, the most important spatial concepts will be described, and the corresponding cartographic exercise will be performed.

The porous city

(...) porosity continues to be a fertile instrument in nourishing ideas, interpretations, and projects for the city and the territory.

Paola Viganò (2018)

The project of the porous city, coined by Bernardo Secchi and Paola Viganò and later explored by other authors, as read above concerns all the angles of the functioning of the city. Even though the analysis of each one of the layers of the approach would be enriching, the following description will focus on the actions mainly directly linked to biodiversity promotion and management, and ecological strategies.

This approach explores the metaphor of porosity that refers to the passage of flows through bodies. Nonetheless, Viganò describes this concept as the resisting of certain flows as well. Porosity is not an equivalent of transparency; therefore, it means the understanding of limitations, the acknowledgement of the capacities of bodies and their flows, and the recognition of the impossibility of full transparency. Porosity implies degrees of transparency, conflict, and tension. It is also closely related to connectivity because both concern flows, the contact between bodies. The relationship between bodies and spaces, and between opening and connections is a constant source of conflict and tension. Conflict, fluidity, and impermanence are essential qualities of porosity (Viganò & Arpa, 2018).

In the book *La ville poreuse*, Viganò and Secchi develop a set of strategies to apply to the counter-porous city: Paris. To them, Paris represents the opposite of porosity, the opposite of an a-centred system; hence, the definition of the non-porous city. As a fragmented, hierarchical, and non-inclusive city, Viganò and Secchi discussed its reconceptualization

to achieve a new structure composed of meaningful places within a continuous urbanity, public spaces, and social and ecological infrastructures (Viganò & Arpa, 2018).

Firstly, the proposal consists of three main trigger layers: the support, the sponge, and the tissue. The first one refers to the territorial supporting of the city beyond the history told by power but read through its geological evolution. The interpretation of natural connective elements proves the city to be an extroverted non-closed entity. The sponge is a porous body by excellence, and it is read in the urban space as toponyms, points, and nodes where all fluids go through. These tell a story of historical appropriation, topographical landmarks, significant moments, and monuments representatives of an identity, which are original positions of connective tissues into the city. Finally, the tissue involves the isotropic figure as the restructuration principle to achieve generalised accessibility (Secchi & Viganò, 2011).

Throughout the description, five strategies are presented, all concerning different strata of topics about current or future problems of the city, and whose analyses are based on the case of study. As previously mentioned, the strategies discussed further down will be directly linked to ecological systems and their management according to the approach: the porous city in link with water and biotic exchanges, and the porous city of percolative biodiversity and green continuity.

The porous city of water and biotic exchanges

The global climatic change is an undeniable circumstance that is affecting the world and, especially, settlements in direct contact with water. In this strategy, the authors create a series of possible solutions to apply in Paris, the case of study, given past events and a non-promising future of rising waters. Consequently, they propose three stances from which all actions come: living with risk, living with nature, and water as a mobility infrastructure.

Living with the risk refers to preventing flooding, the reintroducing efficient systems of rainwater evacuation into the metropolitan territory directly linked to water engineering and land artificialisation. Living with nature examines the construction of reserves and wetlands where biodiversity will thrive while answering to flooding scenarios. Finally, water is a mobility infrastructure regarding the energetic transition and commuting efficiency (Secchi & Viganò, 2011).

The cartography of the proposal consists of different layers based on the previous stances that aim to solve an imminent problem. The first data layer exhibits the wetlands, a result

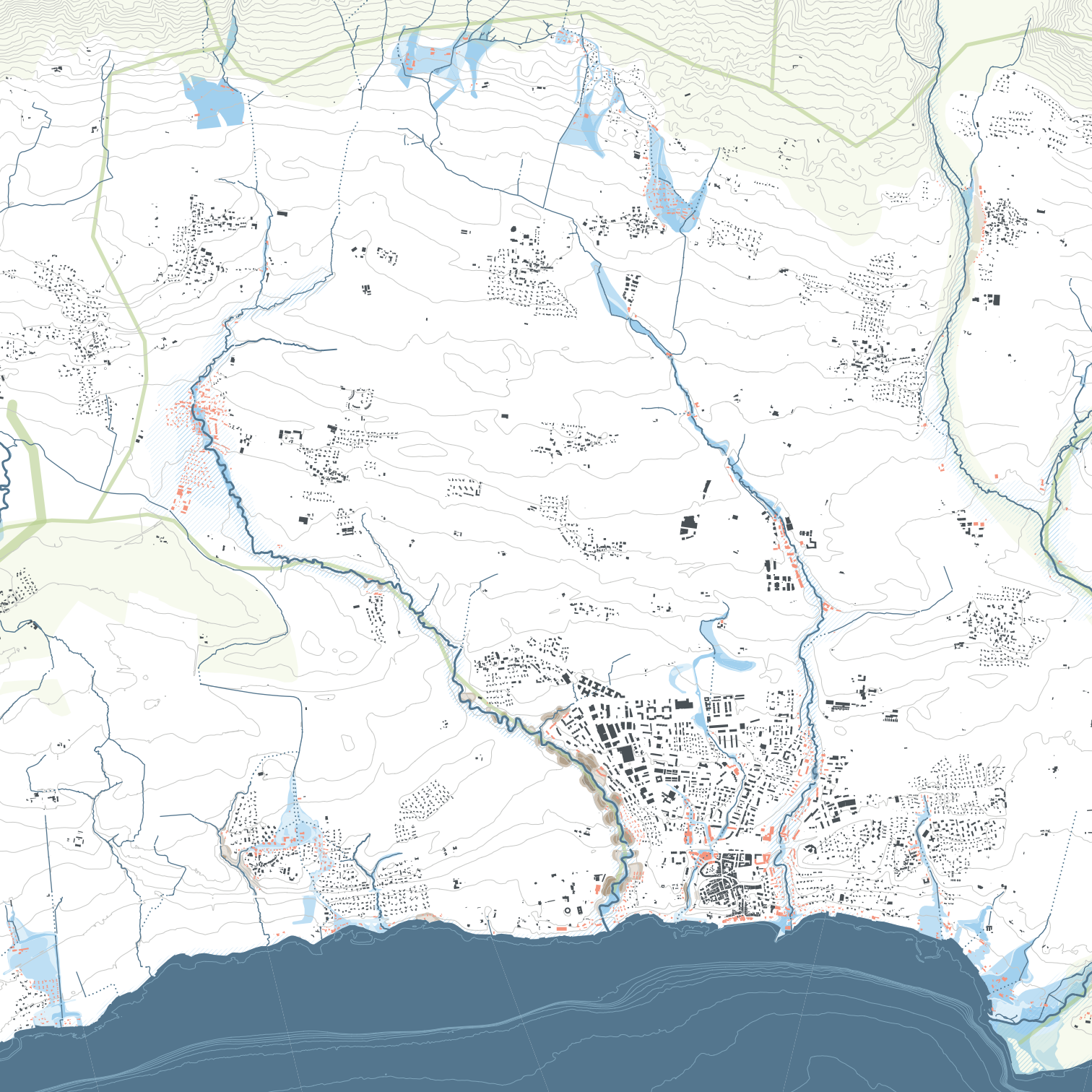


46°23'02.7"N 6°14'48.6"E, 46°23'12.4"N 6°14'26.8"E

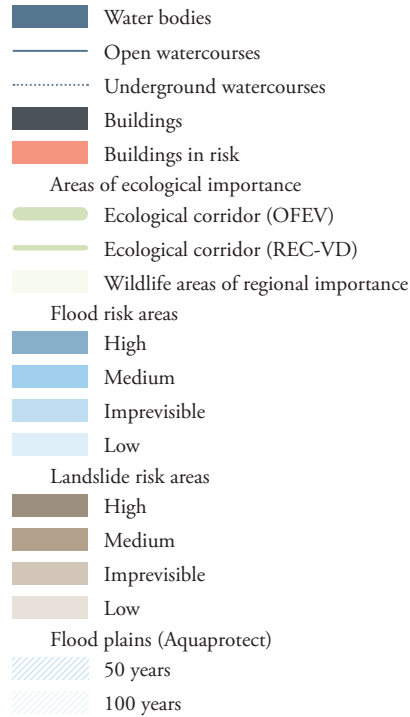
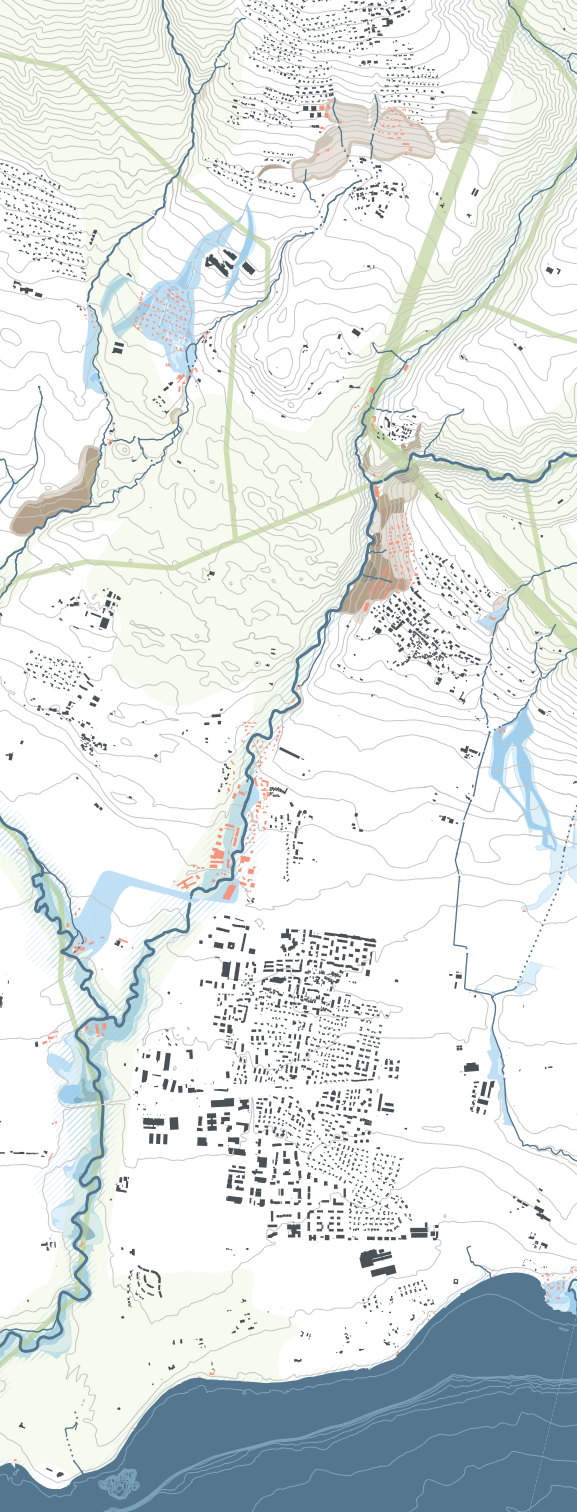
The exit of the Asse stream. Being privatised, it is blocked physically and visibly as well (left), the first direct "entrance" or direct contact with the Asse after almost a kilometre in upstream direction (right).

of the interest in underused or residual spaces in connection to topographical and risk conditions of areas near waterways. Following, the second layer shows the use of ports to make more efficient commuting and merchandise transportation; and finally, the ecological connections through the proposed wetlands as triggers of new biodiversity.

Before the outcome of the synthesis map, several lectures on the site were done to develop those conclusions. A set of cartography of flood risk assessment through time and about the urban landscape, as well as an understanding of the biogeographical regions was done to reach the taken positions and the development of the solving strategies. Even though these actions will not be described in depth, one of the crucial learning lessons to retrieve is how the natural elements were observed and analysed to solve a problem of an imminent scenario: the rising of water levels. The element, in this case, was the waterways and water bodies present in a metropolitan area. Understanding these *flows between bodies*, in this case,



Map 08: the porous city of water and biotic exchanges



Notes

About areas of ecological importance

The two layers of *Ecological corridors* were retrieved from different surveys performed by the Federal Office for the Environment (OFEV) at a national level, and the second one corresponds to studies of ecological connections considered by the Cantonal Ecological Network (REC-VD). The *Wildlife areas of regional importance* were surveyed by Vaud's Cantonal Administration, they include reserves and corridors.

About flood and landslide risk areas

The shown information was retrieved from the Natural Dangers Map provided by the Cantonal Administration of Vaud. The landslide risk areas include both spontaneous and permanent landslide danger zones.

About flood plains (Aquaprotect)

The Aquaprotect flood zones represent a summary overview, on a national scale, of the areas potentially subject to flooding during rare or very rare flood flows created by the Federal Office for the Environment (OFEV).



0 km

+3

quite literally, was the crucial aspect of the lecture on the territory.

While resilience refers to the ability of a system to change as it responds to hardship and to return to its previous configuration once conditions have normalised (Secchi & Viganò, 2011), ecological rationality is the capacity of the human and natural systems to handle problems such as complexity, non-reducibility, variability in space, time and uncertainty (Viganò, 2013). Based on the previous qualities, the lecture on the territory was done to assess its resilience to find potential using existing and new tissues, to create a new nature, and to resist unavoidable adversities.

The porous city of diffused percolative biodiversity and green continuity

Green spaces and agriculture have always been considered to offer opportunities as connective entities capable of being reserves or corridors creating a system of entanglement of elements in the city. They contribute to the porosity of urban and metropolitan tissues, which can be evaluated throughout a milieu that seems continuous.

The metropolitan space can be perceived as a continuous environment which is porous and capable of allowing flows within. This alludes to the idea of the urban sponge, an element that can be described by macroscopic and microscopic variables. The macro-scale tends to see the milieu as a continuous entity, while the micro-scale reads the environment in a smaller spatial dimension capable of distinguishing details in the scale of the plot. Each point of the macro-scale can be associated with a *reference elementary volume* (REV) of comparable dimensions to the micro-scale (Secchi & Viganò, 2011). The synthesis cartography of the proposal considers several layers to read these porosities. The first layer interprets the topographical conditions that play different roles in the ecological system of, in this case, Paris. These conditions show potential areas to create percolation within the systems. The second layer shows the location of needed biological agriculture in water retention areas due to pollution created by typical agriculture practices, along with the reinforcement of buffer zones in riparian areas. Lastly, the third layer exhibits the key parks to modify to encourage appropriation instead of separation and distancing, which is the original state.

As the previous strategy, previous to the synthesis map of solutions for the identified issues, a cartographical analysis was made to reach those solutions. A *dross* mapping was conducted to identify potential areas for land use modification, showing industrial and commercial areas, marshall yards, quarries, and landfills. The cultural and leisure facilities were mapped, as well as the ecological conditions such as waterways and water bodies,



Parc Perdtemps, Rue des Marchandises 2, 1260 Nyon

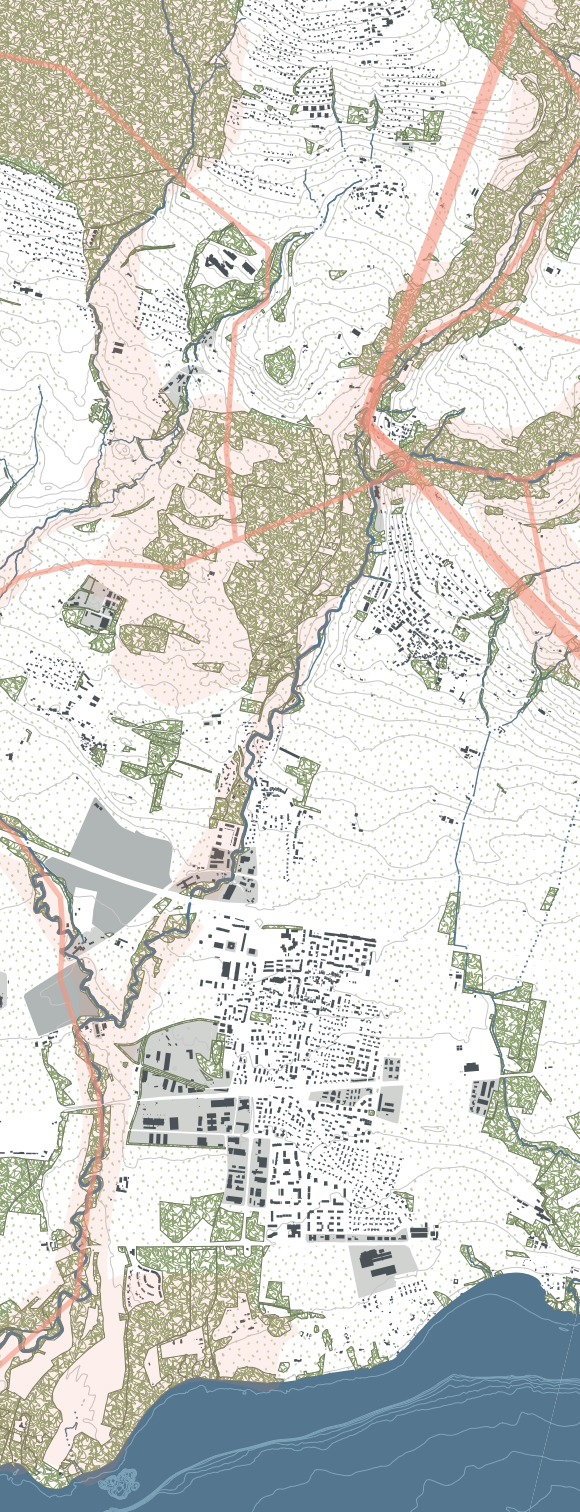
Area of the future Place Perdtemps where today a parking lot is still found. The competition for the design was organised by the communal administration of Nyon and the winning project belonged to the landscape architects Paysagegestion.

woodlands, topography, agricultural zones, and ecological corridors to understand the extent of the ecological connectivity of the area of study.

The depth of each project of the general strategy will not be detailed, but the method of reading the territory will be scrutinised. All tools and operations relied on hypotheses and concepts supported by various mediums (maps, photos, videos, models) (Viganò & Grillet-Aubert, 2016). Under the idea of re-use, repurpose and with the transition to new ways of living and mobility in mind, the information layers were carefully chosen to prove the existence of the potential of an area. The *dross* areas are the connective opportunities and the strips of *anti-park* aimed to transform underused areas to achieve the objective of the strategy: to create connectivity.



Map 09: the porous city of diffused percolative biodiversity and green continuity



- Water bodies
- Open watercourses
- Underground watercourses
- Buildings
- Dense vegetation cover
- Low-intensity vegetation cover
- Potential *dross*
- Industrial zones
- Material extraction and storage areas
- Areas of ecological importance
- Ecological corridor (OFEV)
- Ecological corridor (REC-VD)
- Wildlife areas of regional importance

Notes

About vegetation cover

Both layers of vegetation cover, dense and low-intensity, combine all the layers of information that have been gathered regarding the density of the canopy. In the first case, the areas mostly display woody or forested lands, whereas the second layer shows mostly agrarian zones or herbaceous zones of low height.

About potential dross

In the spirit of Viganò and Secchi's exercise, the *dross* identification was performed. Nonetheless, the viewable information corresponds to zones of use retrieved from the Geneva and Vaud cantons which provide no information about use intensity or type of industries. Hence, the data remains very general and not reliable.

Remarks

The *dross* areas are not as relevant as they were in the Paris exercise performed by Paola Viganò and Bernardo Secchi as they had a different connotation for the landscape. Even though they do show a connective potential, they are not as marked in the landscape in most of their sprawl. Yet, some material extraction areas are neighbouring zones of ecological interest. Thus, their impact should be scrutinised.

Main barriers, such as the road system are not presented, and this might create an idea of connection that is not present. Additionally, because of the unnoticeable subtleties from non-available information from the used metadata (such as smaller-scale barriers or canalisation), the spatial connectivity should be analysed closely.



0 km



+3

La diversité de paysages est aussi liée à la diversité de ses usagers : des lieux différenciés peuvent être attractifs pour des individus différents (...) La biodiversité devient la catalyseur de la socio-diversité.

Bernardo Secchi and Paola Viganò (2011)

The repurposing of, current and future, underused or of negative reputation areas would create ecological and social porosity. The new landscapes responding to local conditions would enrich the ecological system and trigger social diversity. Proposing a new ecological and social continuity through repurposing and rehabilitating existing areas of great potential but under—or wrongly—linked is a step towards a porous city.

Le tiers paysage

Entre ces fragments de paysage aucune similitude de forme. Un seul point commun : tous constituent un territoire de refuge à la diversité. (...) Cela justifie de les rassembler sous un terme unique. Je propose le tiers paysage (...)

Gilles Clément (2020)

Developed by Gilles Clément and later adopted by multiple authors of different fields, the theory of the *Tiers paysage* is interested in the *délaissés*. The valorisation of these spaces emerges from an interest in protecting and preserving life. The diversity of the *vivant* or the biodiversity is catalogued as one of the key elements of evolution. Therefore, the *Tiers paysage* directs its lectures by the ecological richness provided by such spaces and not by the land value found in the land register (Clément, 2020).

In comparison to the previous lectures on the territory, the *Tiers paysage* focuses on neglected spaces found anywhere in the *jardin planétaire* which act as refuges for ecology. The third landscape is then composed of three main elements: the *délaissés* (derelict lands), the reserves and the *ensembles primaires* (primary units), excluding residual or used spaces by livestock, cultivated plants or organisms dependent on farming areas.

Translation to English: “Landscape diversity is also linked to the diversity of its users: different places can be attractive to different individuals (...) Biodiversity becomes the catalyst for socio-diversity.”

“There is no similarity of form between these fragments of landscape. What they have in common is that they all provide a haven for diversity (...) This justifies bringing them together under a single term. I propose the third landscape (...)”



Parking du Martinet, Chemin de Prélaz 1, 1260 Nyon; 46°22'29.7"N 6°13'42.4"E; 46°22'49.8"N 6°13'51.8"E
Abundant délaissé found in a parking lot (left), derelict land next to Nyon's Tennis Club (middle), délaissé following the railways of Nyon's train station (right).

Délaissés or derelict lands

Firstly, the *délaissés*, or derelict lands in English, are spaces which were once exploited and are now abandoned. They can originate from all types of land uses, commonly derived from agriculture, industrial, urban, or even tourist uses, but can be found anywhere. Hence, depending on their management and land use planning there is always a resulting administratively unprotected derelict space (Clément, 2020).

As aforementioned, they derive from all uses. In the case of rural zones, they are found in uneven plots incompatible with exploitation machinery and all residual spaces of land management. Second, in urban areas they are present in plots waiting for the start of a project, suspended due to budgetary obstacles or even because of political decisions (Clément, 2020). In general, they are as present as the urban tissue is dispersed and are encouraged by topographical steepness.



Coinsins © Aéroport de Lausanne, 1960.

The Bois de Chênes in the commune of Genolier, part of the agroecological region of La Frontière, could be considered as a reserve.

They are the genesis location of a secondary landscape which is characterised by a strong dynamic, heterogeneity and chaos (Clément, 2020). They are the home of pioneering species which attempt to colonise these spaces and whose cycles are not permanent, but rather fast. The lifespan of *délaissés* is brief, as they serve as a transitional stage to a permanent one where exogenous species might resist and blaze the trail for indigenous species.

Reserves

The reserves are natural unexploited lands that human activity has not yet reached because of chance or because their natural conditions imply great costs for their usage, hence, it is by an administrative decision from which they obtain a protection status. These are units catalogued as fragile, rare, or even sacred where the climax is found, which are stable levels whose aspect modifies hardly through time (Clément, 2020). The species found in



Jura, 46°27'56.034"N 6°07'09.929"E © CNES, Spot Image, swisstopo, NPOC, 2023

Foothills of the Jura near Nyon. Even though the Jura has not remained completely intact, it has as a global entity. Hence, it could be considered as a primary unit.

reserves are only indigenous and exclusive to external stimuli, these are the spaces of resistance of the *brassage planétaire* or the planetary intermixing.

Ensembles primaires or primary units

The *ensembles primaires* are natural lands which have never been exploited for strong diversity. They correspond to habitats providing the optimum quality of life for species responding to the natural conditions and where the climax is also found. They are the home of the greatest biodiversity on the planet and, as reserves, are closed entities hostile to exogenous species, resisting planetary intermixing (Clément, 2020).

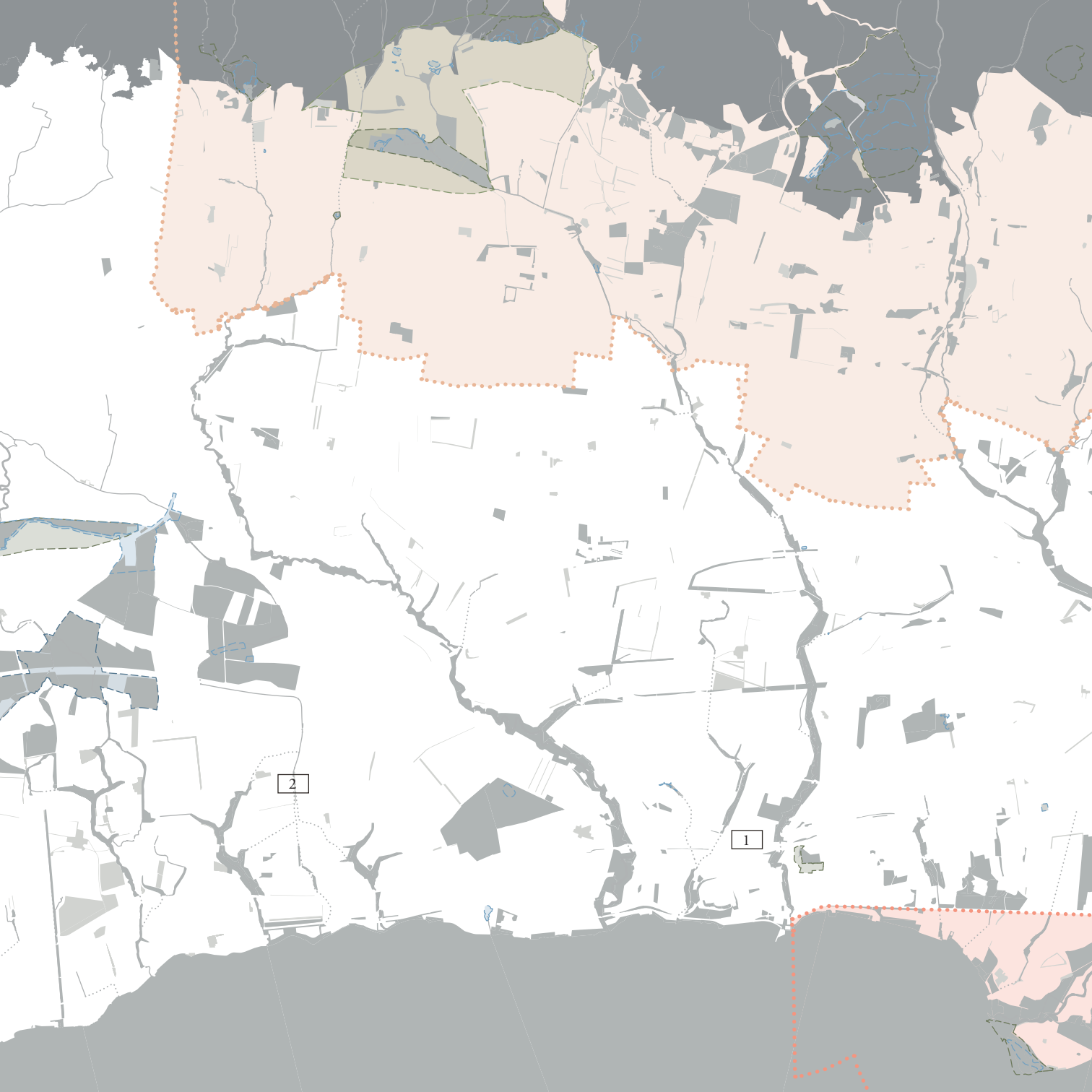
The representation of the Tiers paysage depends on the geographic limits appearing in the frontiers between exploited and non-exploited lands. The current status of *délaissés*, even

if they already evolved into woodlands or other milieu, does not change their past condition. While there are no limits between reserves, primary units or current or past derelict lands, they are all part of the third landscape. Managed environments, such as forests, are not. According to Clément (2020), all elements within the third landscape can be mapped in the same manner: as refuge territories for diversity, a territorial continuity. This continuity can be massive, in reserves or primary units, or as biological corridors, in derelict lands.

This non-exhaustive description of what the *Tiers paysage* is, finds potential in areas that are normally ignored, neglected, or completely ostracised from exclusively natural or designed *green* spaces. Gilles Clément proposes a reading from a landscape designer's perspective understanding of an urban landscape ecology, mutating and constantly evolving and in direct contact with human activity. He explains the process of *anthropization* is the creator of more extensive *délaissés* and more reduced *ensembles primaires* (Clément, 2020). Humans are not seen as external superior beings but as another species interacting with non-human ones in the same medium. In comparison to biodiversity, the human species does not adhere to ecological conditions, it reaches all climatic and living conditions. Due to human activity spread, a decrease in the availability of the *Tiers paysage* happens and, hence, a loss in diversity. The permanence of the third landscape is directly related to human practices and sprawl, and its presence represents a pressure in the subsistence or perishing of the landscape.

The *Tiers paysage* relation to time is unpredictable because it relies upon the biological dependence of a system and the adjustment periods of the diversity to the environment. Thus, it does not evolve according to simple temporalities, but to biological processes.

Acknowledging that part of the *Tiers paysage* is given by administrative decisions for conserving a certain ecological system adheres to a political dimension depending on a collective conscience. Its territorial evolution is proportional to urban planning since a growing sprawl increases the number of derelict lands. This does not mean urban expansion is equivalent to a rise in the global surface of the *Tiers paysage*, it can be the contrary, provoking a greater fragmentation (Clément, 2020). It is the institutional *neglect* of these areas that contributes to their persistence. These areas are to be left alone, to develop on their own; by neglect, it does not mean complete abandonment, but rather the non-institutionalisation of their use. The non-institutional use of these spaces is a natural evolution, sharing the territory between all beings.

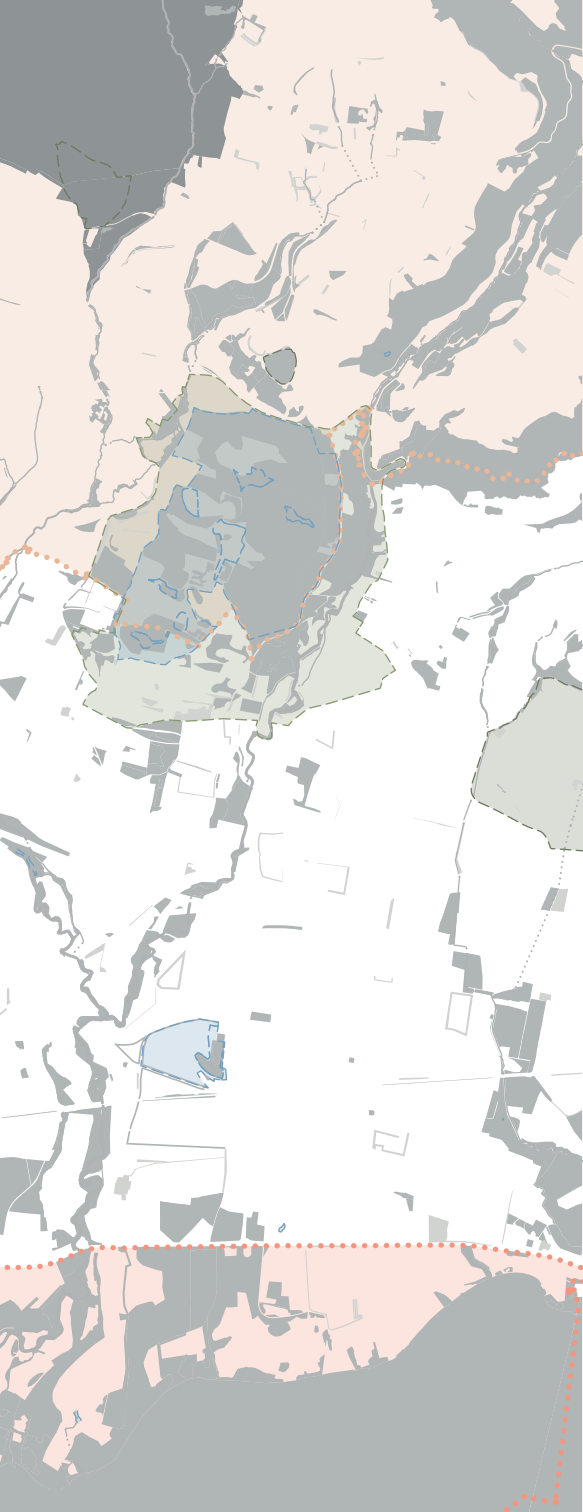


2

1

Map 10: *le tiers paysage* - the third landscape

- Primary units
- Reserves
- Derelict lands
- Protected areas or areas of ecological interest
 - Amphibian breeding sites of national, regional or local importance
 - Alluvial zones of national, regional or local importance
 - Wildlife reserves
 - Natural monuments and sites (IMNS)
 - National importance parks
 - Reserves of waterfowl and migratory birds



1. The third landscape in the city



2. The third landscape in agrarian zones



0 km

+3

Notes

About categorisation

The categorisation proposed between *primary units*, *reserves* and *the derelict lands* depended heavily on the metadata gathered. The primary units correspond to the densely vegetation areas closer to the Jura. This natural zone is thought to be part of the primary units because even though there has been construction in particular areas, it still is a crucial natural habitat of great extension that provides important services. The reserves were identified by the use zones marked as non-buildable woody, forested or vegetation areas. For the derelict lands, some areas of promotion of biodiversity were considered that are left to grow wildly or that are not exploited, such as hedgerows, cultivated strips or fallow lands.

About protected areas or areas of ecological interest

Half of the layers (*Amphibian breeding sites*, *alluvial zones*, and *natural monuments and sites*) were retrieved from the Cantonal Inventory done by the Vaud Cantonal Administration. The *Wildlife reserve* and *National importance parks* were obtained through metadata by the Vaud Cantonal Administration. Lastly, the *Reserves of waterfowl and migratory birds* were collected from surveys done by the Federal Office for the Environment (OFEV). No information was found for the France area.

Remarks

This exercise provides an interesting visual that resonates closely with the concept of connectivity that has been described by various authors. The general information used to display the third landscape is not as precise, hence, the close-ups were pertinent. These prove that there are hidden *jewels* in spaces where nothing is thought to be.

It is important to mention that, even though the general idea of the third landscape is interesting, the political aspect proposed by Gilles Clément is probably not the most accurate when assessing the connectivity of a landscape. Planted or designed areas could perform roles as connecting landscape elements and should be recognised as such. Nonetheless, this spatial concept reveals hidden but rich habitats that are part of a greater system.

In practice

In conversation with Lou Waguét,
architect and project manager in the office
Paysagestion

Every site is different, and we function by feeling. The idea is to understand the site fully and surveying is key for us, especially the site visits. We also do archive and historical research and then complement it with the information provided by the client or collaborators, as we are not experts in executing specialised reports. We also do participative workshops with sociologists and the population to understand how they live their space, and what they expect, fear or need.

One responsibility of our field is to address mobility. This implies a massive amount of reflection on transportation which we do alongside a mobility engineer. In the design process of a project, there is always multidisciplinary work. Depending on the site or the project requirements, we are in contact with specialists to contribute and deepen our territory understanding. As landscape architects we are generalists. We are not biologists or ecologists. Our work in the parking lot of Perdtamps was based on the recognition of wildlife. In terms of biodiversity, it was limited, so we identified the tree patrimony to preserve which is a highly politicised topic. The project aims to connect to the green, blue and brown existing networks. We were highly inspired by the history of the site. In the past there were meadows in the area, so we tried to bring them back along with generous arborisation. Also, we were asked to create a project where life and multiple uses could take place. Again inspired by the past, we saw that this was the place of leisurely walks and playgrounds, a concept that we were keen on generating.

In our office, we establish recommendations, and we work on urban strategies of several communes in Switzerland, one of them being Nyon. We think today's strategies are appropriate but could be pushed even further. Some of them should be stricter and others could remain as advice. Biodiversity should not be completely accessible to humans. Both can coexist but prudently. When we propose biotopes in our projects, we make sure they remain as spaces for wildlife only. Employing natural or typical barriers, we slow down human movement. Moreover, when there is accessibility, it should be for everyone. It is a matter of balance.

17.11.2023

In conversation with Paola Viganò,
architect, urbanist and professor at the
École Polytechnique Fédérale de Lausanne
(EPFL) and at the University of Venice
(IUAV)

The main reason we use this very abstract and metaphorical concept of porosity is because it combines the social and ecological dimensions. From the ecological perspective, we can say that porosity concerns the flows of living entities, for example, water through substances or materials. The question to ask is how to permit a river to flow without being completely manipulated or how can the city turn into a host and crossing path for wildlife. Some conflicts and tensions arise because of these flows. From a societal angle, social landscapes are as important as green ones, because they generate atmospheres.

In the case of Paris, tourism shapes the city and creates areas of contrasting socio-economic levels. This extremely expensive city has made efforts to implement social housing that has only made the rich-poor gaps bigger and has still missed the intermediate layer, the everyday landscape. Speaking of porosity, we can also talk about the capacity of an urban space, a built or non-built space, to adapt, to contain, to welcome, to let through or to block these flows. The lack of accessibility constructs invisible walls. These refer to spaces that are not welcoming and where one would not be at ease. You do not go to certain neighbourhoods because you do not want to see some things. You have your invisible walls inside the city.

Porosity is a reflection of both ecological and social flows, movements and capacities of the intersection of bodies. We need to emphasize biodiversity, but also social diversity. We liked the idea of working with one concept that integrated two fundamental aspects. For any urban reflection, you have the society you are working with and the living elements that have always been neglected. Yet, if we had to redo this study today, we would put much more emphasis on drought, not just the flood. For example, one question that is raised today is how all the new vegetation planted will be sustained.

Porosity is about the movement of bodies. The idea of friction will also be provoked by the new animal presence and how we are ready to have it or not. We have to be prepared for the fact that we want this shift, but culturally, people are not there yet. This will not be easy and brings back the question of porosity: are we ready to have this flow, being at the same place at the same time? To make this kind of reflection you need to go beyond, which is not a simple matter. I think we will need time to go beyond these negative ideas we have about nature.

04.12.2023

Lessons learned and re-interpretations



Les projections dont je l'enrichis [la valeur attribuée à la configuration du paysage], les analogies que je fais spontanément résonner à son propos font partie intégrante de ma perception : c'est pourquoi, bien qu'identiques, ton paysage et le mien ne se recouvrent pas.

André Corboz (2001)

The landscape has countless layers that cannot be comprehended all at once. Any territory reading will inevitably be subjective, it will always be the medium to prove a hypothesis, understand a specific phenomenon, study an evolutive process through time, and always correspond to the view and aims of the creator. As stated by André Corboz in the passage above, the landscape changes depending on the eyes from which it is seen.

Throughout the previous chapter, we have appreciated a set of readings that, although were always done from a certain interpretation of ecology, have shown a varying and transforming landscape. For a long time, the discipline of urbanism has experienced key conceptual shifts that have slowly begun to integrate ecology into its reading lens. In today's global scene, ecology is a crucial angle that should be taken into consideration before, during and after any intervention of a territory.

As the two landscape ecology theories have proven, the *green* or *natural* areas are much richer and more complex in interacting with the same, similar or differently-natured habitats. As urban planners and architects whose common reactions to discern a territory consist of complexification, simplifications and abstractions, inspiration can be drawn from ecology-based approaches. Therefore, a hypothesis is formed: it is through ecology that a sensitive interpretation of a landscape for humans and non-humans is achieved.

This section will present the methodology used to make the cartography presented for which on-site visits were performed. These promenades on the studied territory provided a finer experience and resulted in remarks that will be shared, and which will complement the lessons learned from the explored theories. Finally, retrieving the most pertinent concepts will conclude with the proposition of a new type of reading sensitive to biodiversity structure and dynamics.

Translation to English: "The projections I enrich it with [the value assigned to the landscape's configuration], the analogies I spontaneously conjure up about it, are an integral part of my perception: that's why, although identical, your landscape and mine don't overlap."

Methodology

The urban project is considered not only a potential threat to the natural environment but also a lever to work along with ecological systems to reinforce them and valorise them (Viganò et al., 2020). Throughout the work, the main objectives were the following: (1) generate a strong theoretical framework of landscape ecology, (2) propose the operationalisation of these theories to use during the urban project process, and (3) refine territorial readings by making them sensitive to biodiversity structure and functioning for responsible and sensible project generation.

Acknowledging how challenging territorial studying is, notably regarding the multidisciplinary aspect, a methodology was followed to clarify the outcomes at each step. First of all, a start of a theoretical base was made to identify the main concepts to pursue on-site. Two main selected sources—*Landscape ecology principles in landscape architecture and land-use planning* by Wenche E. Dramstad, James D. Olson and Richard T.T. Forman of 1996 and *Écologie du paysage: concepts, méthodes et applications* by Jacques Baudry and François Burel of 1999—were chosen to retrieve the most important concepts of each approach. Once the step finished, some selected promenades were walked attentively with the focus of identifying the learned notions. There, a site-visit journal was used to register remarks and situations encountered, as well as a respective photographic compendium. With this initial information, a first cartographic approach was executed with the initial mapping scales and topics of interest coinciding with the written base. A further theoretical inquiry followed to finish a description of the commenced foundations where more pertinent sources were consulted to fully grasp the theory and later modify the cartography in terms of scale, representation and topics to demonstrate. During this stage, several interviews were conducted, where experts shared their practical experience regarding their approach to site analysis or project proposal. As the cartographic exercise developed, notes and conclusions were registered.

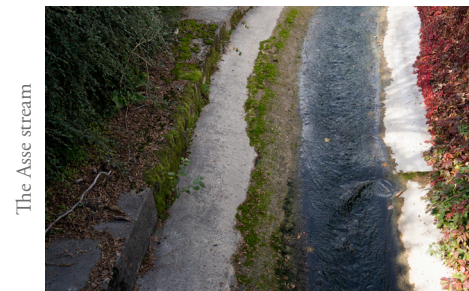
To experience the site first-hand, the theoretical training and the information provided by the experts provided a steady technique to follow for people concerned with space designing and urban planning whose objective is the proposal of conscious, resilient and adapted projects that will host all organisms.

Lessons learned on-site

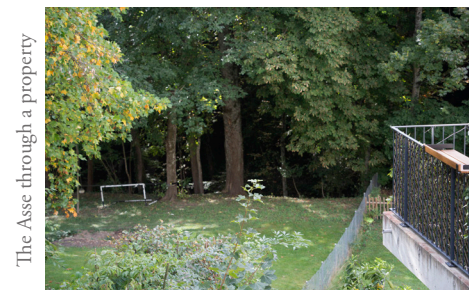
Initially, the desired promenades aimed to follow the two principal stream corridors of Nyon: the Asse and the Boiron. These two elements are crucial markers of the city's landscape, as well as the prominent agricultural lands. Even though it was attempted, it was not possible to walk the entirety of both watercourses because of various reasons. The following portrait will list the faced constraints and other remarks. The visits were performed in late September and early October, as the winter would have changed the viewable dynamics significantly.

The starting point of the first visit was in the output of the Asse stream. This exit was blocked and private. Currently, there is no visibility of the merging of the waterline and the lake, as a private building hinders the passage. The first sight of the Asse is by a small and canalised space between privatised lots, which is still mostly inaccessible except for one maintenance entrance. This watercourse is considered an important conduit for biodiversity according to several surveys such as a watercourse sections with high species diversity or containing priority species at a national level by the Federal Office for the Environment (OFEV), as natural monument in the Cantonal Inventory of Natural Monuments and Sites (IMNS), and as territory of superior biological interest of the Cantonal Ecological Network (REC-VD) of Vaud. Yet it is canalised on an extended portion of its end towards the exit and highly shallow until almost one kilometre upstream.

Both the Asse and its wooded strip are highly inaccessible physically, visually and even sonorously for non-owners of the adjacent private properties. It is only when approaching the spaces between housings that the stream can be seen or heard. Additionally, almost all lots had well-maintained gardens mostly enclosed by hedgerows or barriers along the streets. It is in road



The Asse stream



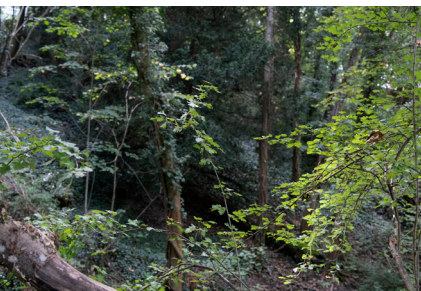
The Asse through a property



Residential street



Derelict land



Unofficial entry to the Asse stream



Sentier du Rocher



Meadow next to railways



Corn crop and cultivated strip

intersections where some *délaissés* appeared, spread randomly throughout the promenade even until the end where they were identified in abundance in a parking lot. These derelict lands were sometimes larger, which resembled a debut of wild meadows. The Asse continued to be inaccessible and was canalised in areas that commonly corresponded with intersections with the road system. Yet frequently piped, there were areas which have been kept close to a natural watercourse state. There are no official entries to the stream until a small pedestrian path called *Sentier du Rocher*. Along the trail, areas of dense vegetation were blocked by barriers. This gesture most probably indicates either privatised areas or the intentional hindering of flows of species (human and non-human). This was the only access to the waterway, not because of an intention of habitat conservation, but due to mostly privatised banks and upper banks.

Later on the promenade some meadows alongside the railways were encountered and it was inconclusive if they were permanent or temporary. The area next to the train rails corresponded to farmlands of great diversity. Habitats such as orchards, temporary meadows, empty fields, corn crops and others were observed. The perimeter of most plots had some type of cultivated strip whose vegetation differed from the cultures. Yet, no bocage-type elements were seen as mostly low vegetation dominated. Temporary meadows, identifiable by random corn plants growing within, were frequent and supported diverse insect and local biodiversity populations.

As previously mentioned, the second visit was destined to walk the Boiron river. Differently from the Asse promenade, this walk started on a higher point upstream near the Tennis Club of Nyon. Here, plenty of *délaissés* were spotted arbitrarily distributed between fields, tennis courts and private buildings. Due to the same issue as the Asse, the Boiron cannot be followed directly as there are no pathways available. Hence, the walk

continued direction upstream through private housing and farmlands. Due to the openness of the fields, the surrounding woody or forested patches were easily visible and identifiable. On the contrary to the other visit, the trails were frequented by multiple pedestrians and cyclists.

As the Boiron approached, the vegetation and temperatures changed drastically. Going from crops and low grasses to woody and forest vegetation with abundant shadow, the warmth dropped significantly, and the humidity rose. There is one pathway available to follow called *Sentier du Boiron* where the banks descend dramatically. This area was a former private garden that became a planted woodland, reason why some exotic flora and tree species are found. It hosted a substantial amount of animal activity. As the walk continued, and the woody areas intersected with farmlands, an interesting vegetation gradient on the soil level unfolded.

The contiguous railways presented meadow-like and ruderal vegetation with rich insect activity. Yet, a high number of barriers were encountered before and after the railway crossing through a bridge. Later, similarly to the previous promenade, a zone of habitation was traversed. Here, random derelict areas appeared once again, this time looking wilder and unkempt. After the residential area, the Boiron was perceived closely through a small bridge. Even though the natural course of the water is modified and receives canalised waters at certain points, there was a diversity of flows and depths. The odours and the sounds of the water were present, and the temperatures dropped anew.

After the bridge, direct access to the Boiron was reached. The vegetation was that of woodlands, cooler sensations, and multiple humus and water smells and sounds gained strength. There was a strong presence of birds, waterfowl, insects, amphibians and small terrestrial animals. The stream seemed

Wooded patches



Sentier du Boiron



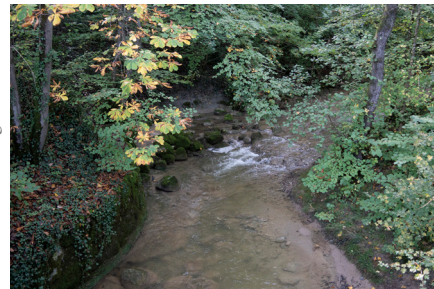
Pedestrians frequenting the area



Ruderal vegetation next to rails



View from bridge to Boiron





The Boiron river



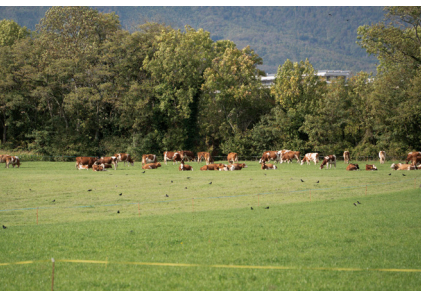
Barriers close to the stream



Bois-Bougy in the background



Bird movement in the Bois-Bougy



Diversity of species

almost unchanged and in its natural state.

As the exit of the opening approached agricultural lands, more barriers began to appear. Once the riparian zone was left behind, the openness of the fields came with a temperature change. Despite the shift of habitat type, the flux of birds did not vary, and other wildlife appeared using or traversing the agrarian patches. The Bois-Bougy revealed on the horizon as a massive element immersed in the landscape accompanied by considerable movement of birds coming and going between woodland patches. Inside the Bois-Bougy, there was a visible gradient of species from the edge to the interior. The edge effect was most likely observed. There was a contrast in temperature between the harsh borders of the surrounding agrarian spaces and the start of the woodlands. The sounds consisted of moving birds and smells of humus-rich soils. Insects, birds and fungi were identified in the interior of the woods.

This brief chronological description highlighted various concerns, with one prevailing: how essential site visits are. They have not only enhanced comprehension of theoretical concepts under exploration, but they have fostered an awareness of overlooked details and significant particularities of the landscape. Matters such as the predominant canalisation of streams, the precarious conditions of certain areas, the fragmentation of watercourses and dense vegetation cover represent aspects that might be disregarded through Geographic Information Systems (GIS) or satellite image analyses. The significance of on-site experiences emerges as instrumental, enriching and deepening the understanding of any given landscape.

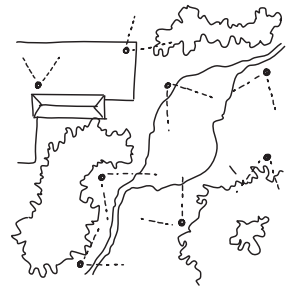
Lessons learned from theory

To learn from ecology is to gain access to a wealth of knowledge and information that the landscape holds. The integration of these theoretical frameworks into landscape or urban planning becomes imperative. The goal of the descriptive exercise was to gather a base of information to provoke a perspective shift through a deep understanding of the landscape. This chapter seeks to unravel a synergy between landscape ecology and urbanism rationale. The operationalisation of these theories will allow us to transcend boundaries by enriching the territory project with comprehension of spatial structures, biodiversity dynamics and changes in space and time. Through a unified lens, the territorial planning process would be refined and deepened, ensuring a harmonious coexistence between human and non-human settlements in natural and anthropized environments.

About methodology

One of the most important steps proposed in the methodology was the on-site visits. In personal experience, witnessing the area of study is crucial as this encourages and develops a certain sensitivity during the posterior mapping and design stages. Particular conditions, such as barriers and valuable connective elements that would be otherwise disregarded can resurface only when the site is experienced first-hand. Although sites of great extent might be impossible to explore in their totality, it is still valuable to tune any reading with otherwise unidentifiable realities on a map. Especially when data is retrieved from Geographic Information Systems (GIS), it can be oversimplified and mistakenly or misleadingly portray information. GIS data from official sites and personal site surveys are complementary and equally highly valuable sources for properly mapping a territory.

The on-site experience refines our vision, and this vision can be equally honed with a strong theoretical background. This is why it is concluded that base knowledge of a minimum of basic ecological principles is decisive for accurate territorial readings and projects. To clarify, we can use

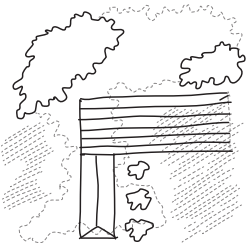


the fine and coarse-grain metaphor. Our theoretical understanding can go from that of a coarse-grain species to a fine-grain one, capable of distinguishing specificities of particular habitats and dynamics. Both theoretical and empirical knowledge is crucial, as the landscape becomes clearer and more approachable.

Concurrently, when examining a territory, it becomes imperative to raise fundamental inquiries regarding its ecology. These questions stem from concepts within landscape ecology's theoretical framework and stimulate analyses concerning areas of conflict or interest. Questions such as the following should be explored: (1) why have some habitats disappeared or persevered? (2) Are these changes due to human or natural disturbances? (3) How has human action impacted the landscape? (4) Has human activity affected the landscape directly or indirectly? (5) Which have been the most important perturbations the territory has gone through? While the existing cartographic exercise executed by architects and urban planners partially addresses these questions, a comprehensive understanding of ecological phenomena can enrich these insights.

In difference to the more descriptive mapping, the cartographic exercise inspired by *La ville poreuse* of Paola Viganò and Bernardo Secchi focused on areas of conflict or potential allowing the generation of real projective hypotheses. By doing proactive readings of high friction areas, positive or negative, and descriptive ones to understand the landscape's structure and dynamics, the comprehension of the territory will be enhanced.

Architects and urban planners are no strangers to historical or evolutive analyses. Not only have these changes originated relevant anthropic issues, but ecological ones as well. Urban sprawl and land-use changes have a considerable impact as they are permanent disturbances of former natural lands. Human activities operate at several spatiotemporal scales where one might identify several levels of organisation in the functioning of a habitat (Baudry et al., 2000). Acknowledging the historical weight an urban settlement has over the evolution of a landscape is a key step towards an in-depth comprehension of a territory. These readings should



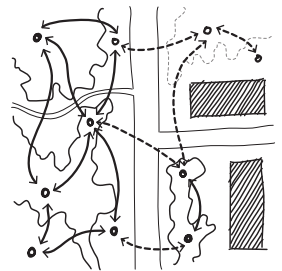
refer not only to urbanisation but equally to the evolution of habitats that have either been completely transformed, persevered or perished. For ecologists or experts in the field, the mapping comes through pixelization which also provides quantitative data. For architects or urban planners, it is still possible to do similar exercises even if the same method is not practised. Calculating the surface area of landscape features can be accomplished using commonly available software or GIS tools. These calculations can provide a preliminary understanding of the situation being studied. However, the findings should always be verified by professionals in the field. Recognising the impact of sequences, such as fragmentation, is pertinent when assessing a landscape and how new interventions can harm or benefit current and future processes.

About landscape ecology's main principles

Landscape ecology, as in all disciplines, is a field in constant development that will continue to adapt as the global environmental conditions do. Yet, both landscape ecology theories described have proven their relevance and validity even years after their establishment, even if some concepts have demonstrated their appositeness and continue to evolve as more studies are executed.

To start, the three main principles introduced by Richard T.T. Forman and Michel Godron: structure, functioning and change used to describe leading aspects of landscape ecology are greatly pertinent and applicable to all landscape elements. Even though these authors' vision of structure is a visually-driven principle that may or may not correspond to the functioning of the elements studied, it provides a theoretical base to start from when debuting on the subject of landscape dynamics. Still, it is important to stress that all landscape components interact constantly indifferently to their nature or the conditions they provide. After following the method, it was concluded that the landscape should be understood as a complex, constantly transforming mosaic in both the short and long term.

The contributions of Jacques Baudry and François Burel are particularly valuable because they open the door towards the analysis of more



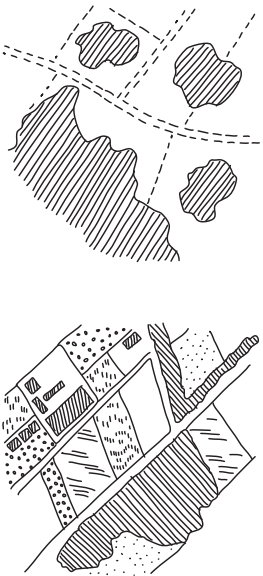
anthropized territories. Heterogeneity turns out to be one of the most important concepts to grasp the landscape mosaic regarding its structure, its connectivity and its temporalities, all resulting in specific dynamics.

Integral urbanism's (Ellin, 2013) main principles—hybridity and connectivity, porosity, and authenticity—link with the notions proposed by both landscape ecology theories. Even though conceived from a societal perspective, they refer to dynamics that work similarly for humans and non-humans. Hybridity and connectivity connect with heterogeneity and connectivity, as they involve diversity-generating movements within different environments. Porosity is linked to permeability and connectivity since it describes the passage or resistance of dynamics through membranes. Finally, authenticity involves the use of existing conditions instead of complete modification or even erasure. These all aim to comprehend, analyse and project a healthy and effective landscape.

About landscape element categories

The categorisation of landscape elements presented by Richard T.T. Forman and Michel Godron is still relevant and used nowadays. This conception generates a first visual understanding of the landscape's structure and functioning. It is important to emphasise that landscape ecology was born with the support of aerial photography, which most certainly influenced the filters from which the interpretations of the landscape were done. The shift from an on-terrain to a bird-eye view mapping resulted in the identification and simplification of landscape elements highly reliant on visual contrasts.

However, the conception of the matrix as a mostly homogeneous and hostile environment of the surrounding habitats should tend towards the understanding proposed by Jacques Baudry and François Burel of the landscape mosaic. It has been concluded that the landscape mosaic is the most accurate way to refer to the general structure of the landscape, this is its complexification as a continuous unit of patches of different nature in constant interaction. The interpretation and categorisation of the mosaic typologies will depend on the phenomenon or species to be



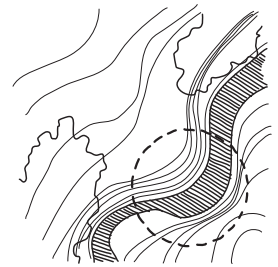
studied, either coarse or fine-grained. Any interpretation of the landscape will correspond to the interest of the observer and will describe, generate hypotheses or reveal areas of high value.

About scale

One of the most critical subjects of any territorial reading is the selection of the cartographic scale. What is crucial to read? What is relevant to observe? The decision-making process of all mappings typically regards only the area of intervention when it should also concern a sufficient area to understand the ecological systems within which the design would be embedded. Any project has a repercussion on its context, and it is essential to understand the role that any modification would have on the landscape, on a micro and macro scale. Once the cartographic scale is defined, the grain of the phenomenon or sample species should be selected. As described in previous chapters, the grain of a species is an important issue to outline, as it changes the resolution and detail needed to distinguish the landscape elements. Ultimately, some questions are to be answered: (1) what would be the extent of the influence of an intervention on the landscape? (2) Which sequences or processes would be affected? (3) Who would be benefited or affected?

About resilience

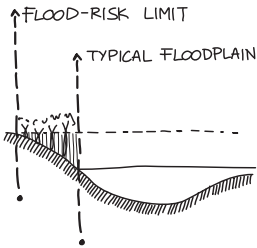
Achieving resilience should be a goal for all designers of space. Given today's scene, this ability is key for the prevalence of natural and anthropized environments that will inevitably undergo from the most predictable to the most unpredictable disturbances. After the cartographic exercise inspired by the theory of *La ville poreuse* (Secchi & Viganò, 2011), flood and landslide risk areas were mapped in Nyon. These phenomena are unavoidable natural disturbances that correspond to existing topographical features. Through their tracing, areas of potential were identified for the proposal of a project that would benefit the biodiversity, but also protect humans from catastrophes and build resilience.



About habitats

As the theory has proven throughout the previous chapters, patches or habitats are landscape components whose comprehension is crucial. Patches are not only present in isolation or as a network, but they are part of the landscape mosaic. The latter is composed of different types of patches and depending on the grain size of the species or studied phenomenon, we can find multiple levels of categories. Habitats are never in total isolation, but this effect still can happen if the surroundings are impermeable for certain individuals.

One of the most important lessons to retrieve from habitat structure and functioning is that patches are commonly the result of perturbations or natural conditions which indicates a certain degree of dynamics happening at a moment in time. These components can be stable or go through sequences that indicate the fluctuation of organism activity. The following points will recall the types of patches proposed by Forman and Godron and suggest how to operationalise the knowledge during the space conception process.



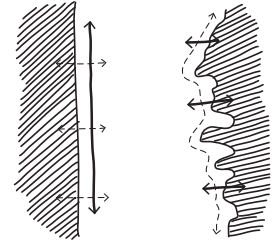
Disturbance patches are typically short-lived. However, when provoked by chronic perturbations, they persist, which ultimately leads to the adaptation of the species to the disturbance regimes. Similarly, remnant patches have analogous time responses towards disruption. The sequences and changes are highly relevant concepts to grasp the influence of any greater intervention on the landscape, especially when it comes to rapidly changing or in-risk areas as previously discussed. This, once again, evokes resilience as an objective to scrutinise. On the other hand, introduced patches are thought to rely on human activity. While it is accurate for urbanised areas, planted habitats could be adaptable to soil and climatic conditions. The introduction of vegetation resilient to current and future disturbance regimes hosting human and non-human dynamics can be explored.

Furthermore, the concept of edge and interior species is one to contemplate as is normally dependent on geographical conditions, such as

sun exposure, wind direction and soil characteristics. Edges are filters capable of changing how exterior influences affect the interior habitat. Not only does their edge and interior ratio indicate certain species' presence but the patch shape also suggests a certain type of movement. Hence, assumptions can be made about biodiversity dynamics and possible areas of value in any site and edge patterns can be translated into transversal or parallel movements to recreate, strengthen or modify during the design process.

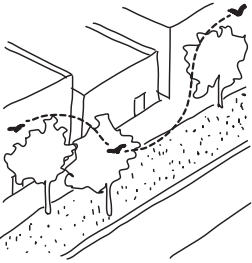
Size is an issue to acknowledge while reading existing or future habitats. However, large patches or linear elements provide undeniable benefits to the landscape. Fine-grained areas within a coarse-grained landscape are ideal for generating large-patch ecological benefits and breadth of environmental resources and conditions (Dramstad et al., 1996) since small-sized components complement and provide important services and connective features. When confronting a constrictive site, the proposition of smaller-scale habitats can still be valuable if placed and connected properly.

Another notion to retain is the idea of heterogeneity and its applications. Firstly, the heterogeneity of a landscape presents in different forms: spatial, which refers to the diversity of patches in a mosaic; or fragmentation, which describes the arrangement of elements that might or might not be contiguous. The first one varies due to the grain size of the species; it can be coarse or fine-grained depending on the habitat needs of each group of individuals. Differently, fragmentation is a temporary stage in a larger series of spatial processes that alter the land (Forman, 1995). Thus, to comprehend the dynamics of a site and predict possible outcomes, it is crucial to determine its phase within a sequence, whether it occurs before, during, or after a disturbance. Hence, heterogeneity is a tool for understanding habitat diversity that implies interactions and resistances, and the possible stages of an ongoing superior spatial process of a landscape.



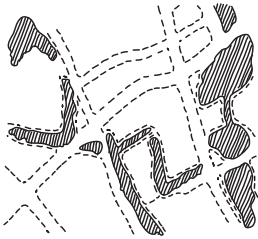
Landscape ecology regards spatial heterogeneity as a central causal factor in ecological systems, and it considers spatial dynamics and ecology's founding concern with the temporary dynamics of the systems to be of equal importance.

S.T.A. Pickett and M.L. Cadenasso (1995)



As highlighted in previous chapters, heterogeneity is one of the most important notions of the landscape ecology theory. This concept permits a deeper understanding of the landscape mosaic's functioning by the recognition and categorisation of habitat typologies to identify landscape units. During the exploration of the *La ville poreuse* (Secchi & Viganò, 2011) theoretical proposal, the mapping of farmlands and dense vegetation areas corresponded to that of a coarse-grain species. Even though it is a necessary step, the spatial heterogeneity can be explored through a fine-grain sample species' vision to strengthen the ecological contribution of the project. By grasping the complexity of the landscape mosaic, assumptions of biodiversity dynamics, a finer choice of spaces or even a plant palette can be reached. Questions like what sort of spaces are to be created, what type of vegetation to plant and for which species, are to be kept in mind.

About connectivity

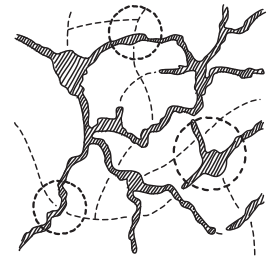


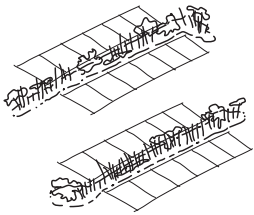
Connectivity in the landscape mosaic is a complex matter that can be analysed through multiple angles. Either by physical continuity, by network or by permeability, it is always there to a certain degree. Primo, corridors are the most recognised connective elements whose design are indicators of dynamics. They display breaks, nodes and narrows. When present in networks, corridors are critical for species movement, principally when found in highly anthropized landscapes. By being conscious of the implications of corridor geometry, assumptions of areas of interest, conflict or conservation importance can be fulfilled during analysis and later project proposal. These elements can be of any patch type providing not only spaces of passage or habitation for species, but ecological services. This is notoriously pertinent for stream corridors, as they are water and

mineral runoff control devices, flood and siltation reducers and soil fertility loss obstacles. For these specific linear elements to perform the aforementioned services, they should have a minimal width. During the design process, these are some of the most important areas to scrutinise. Areas of weakness or conflict can be expanded or reinforced, and optimal zones can be protected or enhanced by their connection to other networks.

The complexification of connective elements through shape variation and route diversification will furnish more intersection spaces, leading to higher species activity. In restraining landscapes, stepping stones are a good alternative between full and null connectivity. Hence, the capacity to read the strengths and weaknesses of the marking connective elements of a landscape is essential to proposing actions that will answer the needs of a landscape. Here, a conjecture is presented: the intersections produced by the superposition of several networks could cause an interesting effect to delve into. If we hypothesize two differently-natured networks, A and B, the narrows of A could be opportunities for node creation by their union with B at those points. Therefore, weakened areas—breaks and narrows—can be enriched with another network, which will provide alternate paths for the inhabitants of those corridors. Suppositions as such can be produced and later confirmed by experts to reach a positive project proposal.

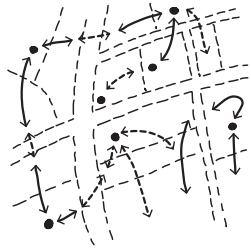
As aforementioned, connectivity goes beyond physical proximity or network presence. Jacques Baudry and François Burel introduced a vision of connectivity where every landscape element is permeable to a certain level. Even human-influenced and dependent lands, like agrarian regions, participate in a landscape's connectivity, providing conditions, permanent or temporary, that act as habitats and are permeable. This is an opening to acknowledge the value of urban ecology. Any space has a connecting capacity to work with. In the landscape mosaic, there is no such thing as a boundary between the start and the end of the city and the countryside, as it is all a complex configuration of habitats. When doing an intervention, the questions to raise are the following: how connected or permeable are the patches of the landscape mosaic? How connected or permeable should





the new proposed patches be?

Throughout the mapping exercise, the urbanised zones in Nyon were perceived as rather hostile with minor spaces welcoming to biodiversity. Although the administration of the city has ongoing projects to remedy these issues, it is accurate that urban ecologies are dispersed and segmented. The lack of public space and the privatisation of pivotal areas, such as the stream corridors, are important obstacles that encumber meaningful connectivity across the built zones. After the cartographic test inspired by *Le tiers paysage* (Clément, 2020), a common problem found in many growing or shrinking cities was raised: the presence of eroded, abandoned and uncared-for lands whose ecological and social potential is undeniable. Yet, the main interest regarding this theory relies on the value given to forgotten lands, not their separation from maintained or planted areas. It is concluded that if these habitats provide the conditions needed for biodiversity protection and survival, no distinction should be made. The political dimension treated by Clément is intriguing, but from an ecological point of view, might not be as relevant to make such differentiation. The third landscape should be a resource to delve into, notably when the site is constraining and limited.



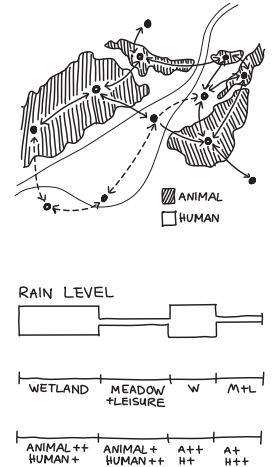
Recalling the concept of porosity by Paola Viganò and Bernardo Secchi (2011), it implies opposition towards certain flows. Some connective elements can also act as barriers to ecological processes or for species movement, which is crucial for the maintenance of equilibrium. A rich and diverse mosaic should be connected, but also resist the spread of undesirable circumstances. Not only does connectivity act inwards, but also outwards. It can be extrapolated to understand the relationship of a project's site with its context. The area of study will always have an initial and final state after any intervention. The role the final result plays will either contribute to or damage the ecological system in which it is embedded, and it is the role of the decision-makers to consider the consequences at different system levels. Diversified networks in shape, continuity and typology might be crucial to creating porosity gradients.

Porosity also—and fundamentally—involves resisting certain flows. Speaking about porosity means understanding limitations (...)

Paola Viganò (2018)

Porosity was developed from a societal perspective, but it is closely related to permeability. The latter allows us to suggest hypotheses regarding species' movement depending on their habitat needs and behaviours. For architects and urban planners, it can be a rich concept to use when understanding the role of a site for a species. By analysing the spatial heterogeneity and fragmentation using sample species, theories can be proposed to answer questions such as when to connect, when to hinder or which role is the project going to play inside the ecological system.

Permeability can be applied to human activity, especially in areas of conservation interest. During the design process, it is important to reflect the target audience for the proposed spaces. What is this place linking? For whom is it connecting it? For whom is it a barrier? As described in previous chapters, spatial and functional connectivity are not synonyms. A gradient can be played with for humans and non-humans, particularly for preservation areas. To define which zones are to be a habitat, a conduit or a barrier is elemental for a harmonious coexistence for all organisms. Additionally, as proved by Jacques Baudry and François Burel, permeability goes hand in hand with seasonality. In the case of agrarian regions, it refers to the use of cultivation fields as a refuge, source of nutrition or other necessary processes for survival for some species in periods. However, the environmental consequences of intensive farming practices are to be considered, in particular, when near stream corridors or water table zones. A change in farming practices or the surrender of plot sections should be encouraged near these crucial ecological system devices. Seasonality can also be used to interpret or create spaces of shared animal and human activity at different moments. A variation of high and low non-human and human activities can be encouraged through design, resulting in a strong coexistence and harmony between individuals.



To conclude, landscape ecology has proven its value for numerous disciplines, and it is especially precious for architects, and urban and land-use planners. These lessons remain theoretical if not taken to reality, and it is during the design process of any small or big-scale project that biodiversity should have an important place. Humans and non-humans are in constant interaction. The idea of isotropic mobility for all beings with their respective degrees of permeability and connectivity should be increasingly promoted.

Conclusions

Ecology is certainly a valuable ally. As seen throughout this work, it opens a door of new possibilities, potentials and constraints that can be otherwise neglected. Landscape ecology is a tool that offers a profound understanding of the interconnectivity between habitats of all varieties and independently of boundaries. In the lessons learned from theory, an attempt was made to operationalise some of the most evident concepts that would build a bridge between design and ecology. As specialised as they were, these types of efforts have huge impacts before, during and after any intervention. Just as explained by the interviewed experts, there is an imperative need for prepared professionals whose reflections include ecological questions.

Le développement durable urbain n'existera pas sans une intégration du système naturel (...) C'est pourtant maintenant un formidable outil opérationnel qui doit trouver ses marques et ses indicateurs en écologie urbaine : indicateurs d'évaluation et de traduction de concepts écologiques (...)

Philippe Clergeau (2007)

From a personal perspective, this exercise has helped in the development of sensitivity. The landscape became a complex playground of constant interactions. Today, the shapes of elements and their disposition in the landscape have a more impactful meaning that goes beyond planting trees or designating green spaces. The landscape mosaic, constantly

Translation to English: "Sustainable urban development will not exist without the integration of the natural system (...) However, it is now a formidable operational tool that needs to find its place and its indicators in urban ecology: indicators for evaluating and translating ecological concepts (...)"

adapting and changing, is a living entity that is necessary to grasp. As stated by Yves Kazémi, this type of exercise clarifies the natural values of the landscape and, subsequently, project ideas arise from them. It is through the portrait and understanding of the past and present state of the landscape that certain ecological treasures or opportunities are revealed.

A door opens

Through this exercise, the landscape of Nyon was unravelled. With each concept exploration, a new territory unveiled. This region, mostly agrarian, has undergone significant demographic and urban growth that has changed its landscape since the 18th century. With the dissemination of extensive agriculture practices, the disappearance of precious habitats and an important automobile flux, the territory has lost a considerable amount of its indigenous ecological values.

On a communal scale, the only strong ecological infrastructure element is the Boiron River. Even though other important watercourses, like the Asse and the Cossy, exist, they are privatised and therefore lack the framework to be considered as corridors. Yet, the analysis of flood and landslide risk zones and the topography indicate an interesting opportunity for expansion. Not only would this improve the services provided by the landscape element, but it would also foment resilience in the adjacent urban zones provided by a new potential wetland network that could extend into a greater scale and the city. Responding also to the administration's interests, the implantation of wetland areas can allow a rich interval of activities, human and animal, during specific periods of climatic perturbations. For example, during rainy seasons, these areas would become active wetlands of mostly animal activity, and on drier periods, leisure spaces could resurface along with adapted vegetation welcoming other human and animal dynamics.

Furthermore, the physical continuity of these waterway corridors is to be analysed, as their breaks, nodes and narrows can be interpreted as areas of potential. To illustrate, the Cossy stream stops abruptly just before the train station and continues underground. How can it be revived? How can it be revitalised? This can also be undertaken through its connection with sub-networks of differently-natured habitats to create a degree of permeability and continuity of social and environmental character.

Inside the city, there is no connecting mesh for watercourse corridors and any other significant habitats. The derelict lands should be explored and enhanced to improve the connectivity of the green network. As explained in previous chapters, stepping stones are

useful instruments to apply when the site is limited. Nonetheless, the modification of certain areas should be assessed to complement the connectivity. The Place de Perdtemps, for example, is a parking lot that will become an urban park. Restructuration gestures such as the latter are needed to create not only biodiversity connectivity but also a strong walkable green infrastructure.

On a regional scale, farmlands are a dominant type of habitat. According to Baudry and Burel, these environments, although often perceived as sterile, still provide opportunities for certain species to participate and connect. Nonetheless, agricultural practices are pivotal aspects to consider, as they can also have negative implications on soil, water table and wildlife. Map 07 (Habitat permeability of the Corn Bunting bird) shows clues about how these zones could play a larger role. These are areas of opportunity for the reintroduction of similar native, but lost habitats once found in Nyon's agricultural and urban spaces to form a dryland network. These new networks could be supported by the existing landscape mosaic. Through its typology identification, compatible habitats can host biodiversity strengthening the green networks of the city. Additionally, a mixed gradient of activity areas of diversified seasonality for humans and native wildlife, such as small mammals, birds and reptiles, could become new hotspots of interest. These project intentions are an example of the multiple reflections that can be triggered from an ecological approach.

C'est en enracinant la connaissance écologique dans le cadre culturel, que la ville peut devenir ce terrain d'interface entre humains et non-humains (...)

Philippe Clergeau (2007)

Even though Nyon is involved in environmental politics, the efforts to achieve a true paradigm shift are high. This work should be taken as a hypothesis and an attempt to create the desired and needed merging of two worlds that, even though related, tend to walk along separate paths. This work was conceived to create ecologically adapted urban areas where both humans and non-human beings can coexist in harmony. The belief is that architecture, urban design, and land planning should consider both biological and social diversities as equally important components of a healthy landscape.

Translation to English: "It is by rooting ecological knowledge in the cultural framework that the city can become this interface between humans and non-humans (...)"

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And finally, to Julien.

Glossary

A

Anthropization: refers to the modification of a so-called “natural” environment by human activities. We can also speak of artificialisation, but this term refers to an advanced state of anthropization. Anthropization is a process, and the result is an anthropized environment.

B

Barrier: in a landscape, an elongated or even linear feature, either natural (watercourse, cliff, etc.) or man-made (road, railway, canal, hedge, fence) that alters the way the landscape functions by blocking the passage of people, animals and materials, and can also limit the field of vision by closing off a view of part of the landscape.

Biological agriculture: type of farming is characterised mainly by the non-use of chemical products and seeks to revive traditional practices such as fallow lands. The term appeared around 1950, to be used in opposition to the agricultural production system based on the use of synthetic products, with producers aiming to label their products.

Bocage (grove): typical agrarian landscape of Western Europe in an Atlantic climate, characterised by enclosed meadows and fields, hedges and scattered settlements.

***Brassage planétaire* (planetary intermixing):** It puts species in sudden competition with each other. The response time to these confrontations coincides with a loss of species (selective pressure).

Break: a discontinuity or gap.

C

Climax: optimum living conditions for the environment.

Coarse scale: in spatial proportion, referring to a large area where the ratio of map length to true length is small. Opposite of fine scale.

Community or ecological community: an assemblage of species at a particular time and place.

Connectivity: the extent to which physical relationships between landscape (and seascape) elements support a full range of natural processes, such as species migration or simply exchanges between sub-populations. It is also the degree to which natural processes are maintained across landscapes. Connectivity is a parameter that measures the processes by which sub-populations of organisms are interconnected within a functional demographic unit.

D

Délaissé (derelict land): it arises from the abandonment of previously exploited lands. It has many origins: agricultural, industrial, urban, tourist, etc. Derelict and wasteland are synonymous.

Disturbance or perturbation: an event that causes a significant change from the normal patterns in an ecological system.

Disturbance patch: an area that has been disturbed within a matrix.

Dross: something of very low quality; the least valuable part of something.

E

Ecological rationality: capacity of the systems to adjust to change, related to resilience.

Ecosystem: all of the organisms in a given place in interaction with their non-living environment.

Ecotone: a relatively narrow overlap zone between two communities.

Edge effect: a distinctive species composition or relative abundance in the outer band of a patch (i.e., different from the species composition or relative abundance of the patch interior).

Edge species: a species found only or primarily near the perimeter of a landscape element.

Edge: an outer band of a patch that has an environment significantly different from the interior of the patch.

Ensemble primaire (primary unit): de facto reserves. They are areas that have never been exploited. They evolve slowly or not at all. The primary complexes are uniform in appearance despite a generally high level of diversity.

Environmental resource patch: an area where environmental resources, such as soil moisture or rock type, differ from the surrounding matrix.

F

Fine scale: in spatial proportion, referring to a small area, where the ratio of map length to true length is large. Opposite of broad or coarse scale.

Flood frequency: the probability, expressed as a percentage, that a particular maximum flood level will be attained during any single year (based on past 100-year periods).

Flood level: a water level attained by a particular flood frequency.

Fractal geometry: a type of geometric object defined by Benoît Mandelbrot, whose length is related to the scale of observation, but which has the same appearance whatever the scale.

Fragmentation: the fragmentation of a landscape into small elements.

Functional connectivity: response of organisms to landscape elements other than habitats. This definition is often used in the context of landscape ecology.

G

Grain size of species: the distance or area to which a species is sensitive in carrying out its functions, such as foraging or absorbing mineral nutrients.

H

Habitat: all the living conditions of a species or a community of animals and plants, as well as the territory in which the species or community lives.

Heterogeneity: this is an essential feature of the objects studied by landscape ecology and one which differentiates it fundamentally from ecosystem ecology since the latter is concerned in practice with homogeneous fractions of territory.

I

Interior species: species located only or primarily away from the perimeter of a landscape element.

Intersection effect: ecological conditions being modified significantly by the presence of an

interconnection of corridors.

Introduced patch: resulting when humans introduce organisms to an area.

Isotropy: isotropy corresponds to an undifferentiated, homogeneous space, devoid of asperities, in which movement could take any direction.

J

Jardin planétaire (**planetary garden**): it represents the planet as a garden. The feeling of ecological finiteness makes the limits of the biosphere appear as the enclosure of living things.

L

Landscape mosaic: a patchwork of different components assembled to form an overall landscape. The actual composition of a mosaic and the way its components are distributed are unique to each landscape.

Landscape permeability: the ability of a heterogeneous area to provide passage for organisms. Rather than focusing on the identification of corridors or patches of connected habitats, landscape permeability takes a broader view of the resistance to the movement of organisms and aims to provide a correct estimate of the relative potential of organisms to pass through complete landscapes.

Line corridor: a narrow band essentially dominated throughout by edge species.

M

Macroheterogeneity: a pattern whereby the assemblage of landscape element types differs markedly in the extreme portions of the area examined.

Matrix: the most extensive and most connected landscape element type present, which plays the dominant role in landscape functioning. Also, a landscape element surrounding a patch.

Mesh size: in a network, the average distance between lines or the average area of elements enclosed by the lines.

Microheterogeneity: a pattern where the assemblage of landscape element types around a point is similar wherever the point is located in the landscape.

N

Narrow: an area in the form of an isthmus.

Node: a patch attached to a corridor, both same landscape element type. Also, an intersection of corridors, and a source or sink of flows of objects.

P

Patch turnover: the rate of appearance and disappearance of patches.

Patch: a nonlinear surface area differing in appearance from its surroundings.

Patchiness: the density of patches, or the fineness of a mosaic.

Percolation: the act of a fluid (generally a liquid, sometimes a gas) slowly passing through a medium (e.g. sediment) in which there are voids, generally from top to bottom.

Porosity: transversal and transcalar concept related to ecology, mobility and social issues, epistemological and mathematical translated into metaphorical and evocative possibilities for movements and flows.

R

Reference elementary volume (REV): in geology, it is defined as the minimum volume of a rock that is representative of any larger volume.

Relaxation period: a time following a disturbance during which the species extinction rate is elevated.

Remnant patch: an area remaining from a former large landscape element and now surrounded by a disturbed area.

Reserves: an unexploited site. Its existence is due to chance or to the difficulty of access, which makes it impossible or costly to develop. It appears by subtraction from the man-made territory.

Resilience: an organism, species or ecosystem that is capable of resisting and overcoming major or minor disturbances (natural or industrial disaster, etc.) to return to normal functioning.

Resistance: designing protected area systems to withstand stress and change and thus

maintain their structural and functional attributes, including future changes such as global warming. A resistant system is less sensitive to disturbance, but once affected, recovers less quickly than a resilient system.

Rest stop: a stop where an object stops for a brief period before moving on.

S

Spatial connectivity: describes the environment and the structural links between habitat patches.

Stepping stones: a spot that is colonised by a species, that is, when the species arrives and successfully reproduces and grows.

Stream corridor: a band of vegetation bordering a stream or river.

Stream order: a pattern of connecting tributaries in which the length of the stream is numbered according to how many upstream tributaries have joined it.

Strip corridor: a wide band with a central interior environment that contains an abundance of interior species.

T

Tessera: the smallest homogeneous unit visible at the spatial scale of a landscape.

Theory of Chaos: is interested in so-called *chaotic* systems, which are highly dependent on initial conditions: a small variation in initial conditions rapidly leads to a completely different result (the famous *butterfly effect*).

Theory of disturbances: spatiotemporal heterogeneity of landscape is the result of natural or anthropic disturbances.

Theory of hierarchy: principle of organisation that manifests itself at several levels in the control of behaviour, with the authority of the dominant over the dominated.

Theory of islands: the species richness of an island at any given time is the result of two dynamic processes: the immigration of propagules and the extinction of populations.

Tiers paysage (Third landscape): a territory for many species that have nowhere else to live. It excludes cultivated plants, livestock, and living beings whose existence depends on farming.

All the definitions were retrieved from the Dictionnaire de la Biodiversité Biologique et de la Conservation de la Nature, the Dictionnaire du Paysage, Écologie du paysage, Landscape Ecology, the glossary of Géoconfluences, the Manifeste du Tiers Paysage, Resilience in Ecology and Urban Design, and the Oxford Learner's Dictionaries.

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