# Ecological networks and ecosystem services in urban regions Implementation and planning practices

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## Introduction

In recent decades, urban developments, agriculture and growth of grey infrastructures have affected urban landscapes. The rapid expansions of cities have increasingly caused loss of biodiversity, degradation and fragmentation of habitats. In this context, Ecological Network (EN) and more recently Ecosystem Services (ES) have been the subject of increasing attention among academics and in global and European policies. EN has represented a concept to consider and plan for preserving biodiversity and sustainable use of resources. EN also provides ES, for instance, recreational services (such as the access to green space, recreation, and educational resources) and supporting services (such as safeguarding biodiversity and protecting natural environment). The benefits provided by those two ES have been mostly emphasised in the research fields of regional and urban planning. In addition, several metropolitan regions and cities have defined objectives that EN is meant to pursue, as well as planning practices to adopt. However, there is a clear difficulty to effectively implement EN concept and adopt sustainable planning practices. Often ENs are not considered within built areas and where new developments are proposed. On the other hand, the introduction of the ES concept is still limited in land use planning. Comprehensive studies on how the concepts of EN and ES have been employed in urban regions are still very limited. This study aims to understand the implementation of EN and ES concept in land use planning and the current use of both concepts in planning practices.

## Background/Literature Review

EN consists of core areas, buffer zones and ecological corridors that are necessary for ecosystems and species to survive in human-dominated landscape (Jongman and Pungetti, 2004). Planning and implementation of EN have been studied since the early 2000s (Jongman et al., 2004, Jongman et al., 2011). Scholars have mainly focused on national and regional approaches to the EN concept and more recently on how the EN concept has been employed at local scale. However, little scientific research is available on the effectiveness of planning practices. In addition to this, more recently, studies have emphasized the importance of EN to provide multiple ecosystem services

(Ahern et al., 2014, Azizul, 2013). The ES can be categorized as supporting services (e.g. soil formation, biodiversity and habitat), providing services (e.g. fish and wood), regulating services (e.g. storing carbon and controlling flood) and cultural services (e.g. recreation, wellbeing and inspiration from interaction with nature) (Millenium Ecosystem Services, 2005). Only recently, the ES have been brought to the attention of urban and regional planning and policymaking (Haase et al., 2014). The benefits from the ES are still unknown for a large group of experts and non-experts (Niemelä et al., 2010). Recent studies have focused on the ES in planning processes, in particular, scholars have analysed how the ES have been taken up in the planning agenda of metropolitan regions and cities (Hansen et al. 2015). Hans and his co-authors stated that when ecosystem services have been mostly mentioned implicitly means that there is an understanding of the urban ecosystems and related benefits, but "there is not a conscious linkage with the ecosystem service concept" (p. 229). Within this context it is still difficult to define the knowledge relevant to ES in planning, considering also that official planners, policy –makers and other who are not enough informed make most of the land-use decisions (Cowling et al., 2008). However, several scholars in the fields of ES argued that the lack of knowledge of ES of cities and urban regions still affects land use planning and management decisions (Niemelä et al., 2010). This is also affecting the understanding of potential benefits of EN.

**Goals and objectives**

The aim of the study is to understand how the concepts of EN and ES have been implemented in the planning documents of metropolitan regions and what kind of planning practices have been adopted by official planners and other stakeholders. Since this was a qualitative study of two cases (the metropolitan regions of Montreal and Milan) the results naturally cannot be generalized to all metropolitan regions, but they can be used to characterize typical advantages, disadvantages and challenges of EN and ES concept in land use planning and mostly referring to highly dense urban regions.

**Methods and study areas**

The analysis of planning documents from the two metropolitan regions of Milan (MRMi) and Montreal, (MRMo) was conducted to explore how the concepts of EN and ES have been already implemented at different level of planning. The analysis was structured to consider the two groups of plans and programmes as follows: 1) comprehensive planning for each metropolitan region (CMM, 2011, PTCP, 2013) 2) master plans and related reports of the City of Montreal and Milan. In total 12 documents have been analysed, 7 from the MRMi and 5 from the MRMo, respectively. The study focused on

analysing those projects in which the EN concept has been developed. In addition, the analysis focused on the explicit and implicit references to ES in planning documents (Hans et al. 2015, Sitas et al. 2012). The semi-structured interviews that consisted of five questions were conducted with regional and city planners and other experts. The respondents stated how the concepts of EN and ES have been implemented and used in planning practices. In addition, they were asked to outline advantages and disadvantages of EN and ES. The MRMo has one of the highest population densities in North America (1,240 inhabitants/km$^2$) (CMM, 2011). The EN concept is rising in popularity in the region, especially between public associations, while the City of Montreal's new planning practices for improving EN are noteworthy. The MRMi with an area of 1980 km2 is inhabited by 3.8 million people and is located in the southern part of the region of Lombardy. Since the early 2000s, the province of Milan has stood out in Italy for being an early adopter of the EN concept, while the Lombardy Region has developed a comprehensive plan for EN and introduced an ES approach a decade later. For a common understanding the study named the province of Milan as metropolitan region. To be precise, the Italian planning system is top-down and based on the hierarchical level. For instance, projects for EN have been developed at the national, regional, provincial and municipal. The study refers to the provincial plans that are still in action, even though a new reform has replaced some of the provinces with the so-called 'metropolitan cities' while others have been merged together. The Canadian planning system is based on provincial, regional, and local governments.

**Results - *Ecological Network and Ecosystem Services in planning practices***

In the MRMi, all regional and provincial plans relevant to EN - that are mostly strategic - have important links with the local level where the implementation of EN must occur (Province of Milan, 2013). However, only a few projects at local scale have been recently developed or municipalities are in the phase of developing plans, and, accordingly, the effective implementation will be seen only in the next years. On the other hand, the Province of Quebec (Canada) provides metropolitan regions with biodiversity strategies that aim to develop EN and other green infrastructures. To this end, the MRMo mostly refers to a wider concept of blue and green networks that enhance "projects for natural environments, built heritage and landscapes for recreational and tourism purposes, while contributing to the protection of natural environments." (CMM, 2011, p. 196). However, the EN concept has been used by the City of Montreal within 10 sectors that are called *ecoterritories*. "These sectors represent considerable tracts of land which include existing protected areas (large parks, nature reserves, etc.), as well as natural spaces in need of

protection and enhancement." (City of Montreal, 2004, p.13). The *ecoterritories* have been initiated by the City in order to lead the development of conservation projects and new urban development projects. The findings from the planning documents analysis show two different approaches to the implementation of EN concept. The first approach has been implemented within the MRMi and refers to a regional ecological corridor the so-called *'Dorsale Verde Nord'* (Fig.1). The second approach is employed at the local scale and refers to the ecoterritory of *Ile forestiers de la Rivier a l'Órme* in the Ciy of Montreal (Fig. 2). The Figure 1 shows a section of the *Dorsale Verde Nord*, a regional corridor of 65 km that preserves vulnerable habitats and wildlife species that move from Ticino Park to Adda Park.

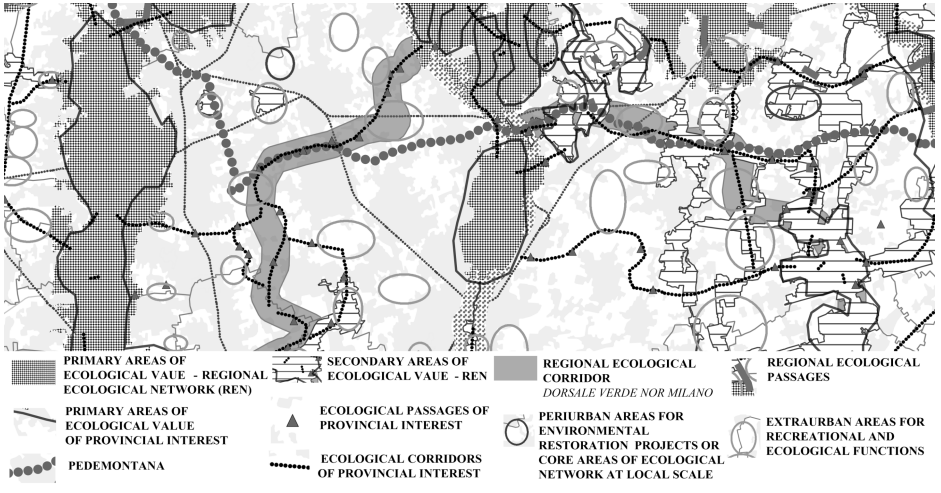



**Figure 1. Pedemontana and regional and provincial ecological networks**

However, the ecological corridor is currently threatened by a new infrastructure, the so-called *Pedemontana* that has been partly built. The highway consists of 67 km that crosses the six provinces of Milan, Bergamo, Como, Varese, Monza and Brianza and covers a regional area of 2000 $km^2$. Environmental compensations, such as a greenway of 90 km, and environmental mitigations, such as green bridges, have been planned and partially executed to reduce the impacts on core areas, buffer zones and corridors. These kinds of conflicts between grey and green infrastructures have happened in the MRMI for several reasons. To this end, the expert in biology and natural sciences –who was interviewed from the MRMi planning department –provided some insights. He said: "Usually we ask for environmental compensations such as creating new forests in alternative sites, when the existing ones are threatened by new constructions. In other

situations, wildlife eco-dots and green bridges are required to prevent further ecosystem fragmentation." In addition, he stated that most of the EN projects have been mainly used to defend green areas and wildlife. The aim is to contain the urban growth rather than direct it in ways that protect habitats in urban areas. In addition, the expert said: "There is still a lack of knowledge between local technicians, policy-makers and developers about EN and ES concept. Very often EN projects at the local scale have been conceived as green networks for recreational uses."

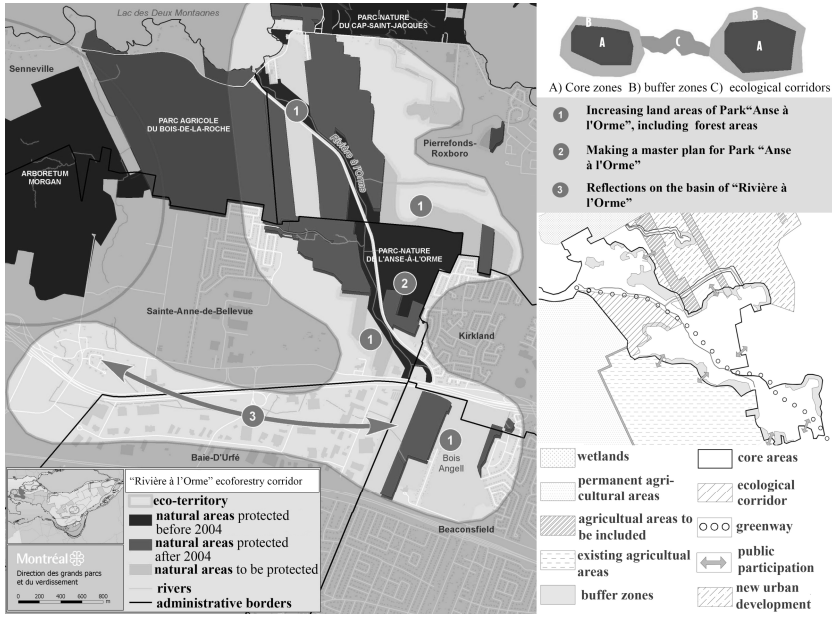
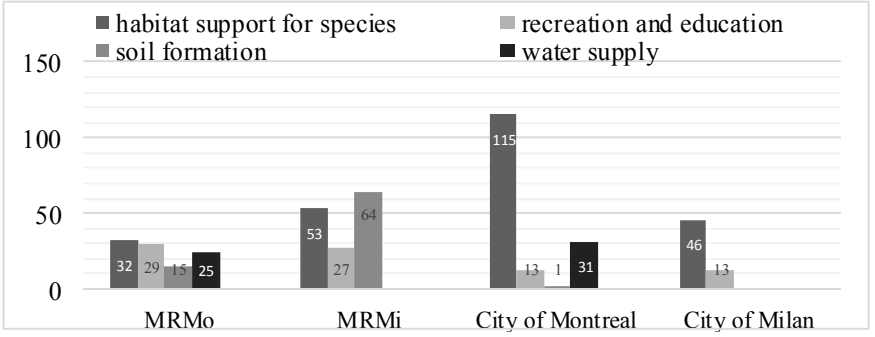



**Figure 2. a) Ecoterritory Ile forestiers de la Rivier a l'Órme, bottom left (City of Montreal, 2013) b) EN model, top right (City of Montreal, 2004) c) EN maps for participatory process, bottom right, redrawn by the author**

The Figure 2a shows that several natural spaces are preserved inside and outside the eco-territory. Based on the EN concept (Fig. 2b) core areas (245 ha), buffer zones (91 ha) and corridors (68 ha) have been identified within the eco-territory. "The actions are based upon the notion of EN and its elements […] around which a development project may be designed" (City of Montreal, 2004, p.13). The EN has been used to lead a participatory planning process with farmers, landowners and local developers (Fig. 2c). By reviewing the planning documents, in the MRMo it was found only one explicit reference to ES that says: "The objectives and criteria of the policy direction aim to give the MRMo measures for protecting natural environments and biodiversity and to benefit from the ecosystem services rendered by these spaces." (p.173). In

addition to this, there is a clear acknowledgment of the benefits that ES provide, such as air purification, climate regulation and carbon sequestration, as well as sociocultural advantages. On the other hand, implicit references are associated to all four categories of ES (Table 1). Habitat for species, recreation and education, soil erosion and water supply are mainly mentioned.

**Table 1. Implicit references to ES in planning documents**




By analysing the planning documents in the City of Montreal, in particular the master plan and related reports, the ES concept has never been mentioned. Most of the implicit references are associated to habitat supporting and cultural services. Also, in the MRMi no explicit references to ES concept were found, while most of the implicit ones refer to supporting and cultural services, as well as soil protection and consumption. In the City of Milan there is no mention of the ES concept, while implicit references are mainly associated to prevention of fragmented habitats and cultural services. However, the regional plans have introduced the ES approach. To this end, a regional planner from the Lombardy Region stated: "ES are often mentioned in the sector plans of protected areas. This can be found in two LIFE projects that are Making Good Nature and MANAGE. The first aim is to identify the ES provided by Sites of Community Importance (SCI), the second one is to quantify the ES values. The official planner stated that the development of mechanisms for payment of ES represents an actual topic. In fact, a successful method may increase the availability of funds for EN and Natura 2000 sites. However, she described: "The introduction of ES concept in urban and regional planning cannot be limited to accounting ES and valuing benefits. The primary goal is to ensure that local ecosystems are healthy enough to bring local and global benefits."

## Discussion and Conclusion

The MRMo and MRMi show different approaches to the implementation of EN and ES. In the context of MRMi political and planning institutions at

regional and provincial level have provided plans and instruments for EN development. However, practitioners, local policy-makers and developers, and other stakeholders struggle to understand that EN provides ES such as habitat and supporting services for species or regulating services for air quality. The EN concept is not yet acknowledged as a strategy to direct new urban developments such as infrastructures and residential areas. On the other hand, in the City of Montreal, the EN concept is employed for building or preserving nature elements into really fragmented urban landscapes, as well as directing the participatory planning and design process within the city. In addition, in both metropolitan regions, even though ES represent part of the conceptual framework of EN, the ES concept has not yet acknowledged. In fact, only one explicit relationship between ES concept and policy directions have been found within the planning documents analysed. In addition, the interviews provided an in-depth understanding of the challenges that official planners are currently experiencing when implementing EN and ES concept. Unlike the City of Milan, the City of Montreal include departments responsible for biodiversity. In particular, the City of Montreal has a biodiversity division that is located within the town development and it works in tandem with the division of parks and green areas. Probably, the introduction of new regional and urban plans - that recognizes the ecological functions and protects the environmental characteristics of a region and its landscapes - is not sufficient. In addition to increase the protection of natural environments and ecosystems by promoting sector plans, those departments should contribute to lead - rather than encourage - high-quality urban planning and design. This study, however, represents a first step towards the further investigation of the implementation of EN and ES in planning practices. For instance, additional research might focus on interviewing other official planners, experts and actors to better understand the reasons for the slow employment of ES. This might also help to better understand the current use of EN concept and its effective implementation within the built environment.

## References

Ahern, J., Cilliers, S., & Niemelä, J. (2014). The concept of ecosystem services in adaptive urban planning and design: a framework for supportive innovation. *Landscape and Urban Planning*, 125, 254-259.

Azizul, M. F. (2013). Extending the roles of ecological networks in a sustainable landscape. *Nordic Journal of Architectural Research*, 2,111-134.

City of Milan (2013). *Piano di Governo del Territorio* [Master Plan, General Report] Available at

http://www.comune.milano.it/wps/portal/ist/it/servizi/territorio/Pianificazione_Urbanistica_Generale/Piano_Governo_Territorio_Vigente/DDP_Vigente/DDP_RG_DOCUMENTI_INTRODUTTIVI (accessed January 12, 2016)

City of Montreal (2004). *Policy on the Protection and Enhancement of Natural Habitats*. Available at http://ville.montreal.qc.ca/pls/portal/docs/page/nature_en_ville_en/media/documents/ppmnang060123.pdf (accessed Februay 15, 2016)

City of Montreal (2013). Bilan 2009 - 2013 *Politique de protection et de mise en valeur des milieux naturels* (Policy on the Protection and Enhancement of Natural Habitats, Montreal. Available at http://ville.montreal.qc.ca/pls/portal/docs/PAGE/GRANDS_PARCS_FR/MEDIA/DOCUMENTS/BILAN%20POLITIQUE_2009-2013.PDF (accessed March 1, 2016).

CMM, Communauté Métropolitain de Montréal. (2011). *An attractive, competitive and sustainable Greater Montreal*. Available at http://cmm.qc.ca/fileadmin/user_upload/pmad2012/documentation/20120813_PMAD_eng.pdf (accessed March 10, 2016).

Cowling, R.M., Egoh, B., Knight, A.T., O'Farrell, P.J., Reyers, B., Rouget, M., & Roux, D.J. (2008). *Ecosystem services special feature: an operational model for mainstreaming ecosystem services for implementation*. In Proceedings of the National Academy of Sciences of the United States of America, vol. 105, (28), 9483-9488.

Hansen, R., Frantzeskaki, N. McPhearson, T., Rall, E. Kabisch, N. Kaczorowska, A. Kain, J-H. Artmann, M., & Pauleit, S. (2015). The uptake of the ecosystem services concept in planning discourses. *Ecosystem Services*, 12, 228–246.

Jongman, R.H.G., Külvik, M. & Kristiansen, I. (2004). European ecological networks and greenways. *Landscape and Urban Planning*, 68, 305–319.

Jongman, R., Pungetti G. (2004). *Ecological network and greenways, concept, design, implementation*. Cambridge University Press, Cambridge.

Jongman, R.H.G., Bouwma, I.R. & Griffioen, A. (2011). The Pan European Ecological Network:PEEN. *Landscape Ecology*, 26 (3): 311–326.

Niemelä, J., Saarela,S.R., Söderman, T., Kopperoinen, L., Yli-Pelkonen, V., Väre, S., & Kotze, D.J. (2010). Using the ecosystem services approach for better planning and conservation of urban greenspaces. A Finland case study. *Biodiversity Conservation*, 19, 3225–3243.

Millennium Ecosystem Assessment (2005). *Ecosystems and Human Well-being: Synthesis*. Island Press, Washington, DC.

Province of Milan (2013) *Piano Territoriale di Coordinamento Provinciale* [Territorial Plan of Milan Province]. Available at http://allegati.provincia.milano.it/pianificazione/allegati/piano_territoriale/PTCP_vigente_2014/Relazione_generale.pdf (accessed April 1, 2016).