3 The challenges of engendering ecological connectivity – Topics and impacts

Introduction

This chapter investigates the multitude of challenges that arise when planning and implementing ecological connectivity measures. In the first contribution, Thomas Scheurer, from ISCAR, looks at the planning process in dynamic landscapes and discusses the opportunities and limitations of spatial planning in this process. In the second contribution, Karin Svadlenak-Gomez from the FIWI and Marianne Badura from blue! look at the pressing problem of stakeholder participation in the decision-making process. They describe and discuss the "empty chair" situation encountered by numerous initiatives that fail to motivate and engage adequate stakeholder representation. In the following contribution, Florian Kraxner and his colleagues from IIASA, examine the expansion of renewable energy production and the opportunities and conflicts that arise in reconciling this development with biodiversity and ecological connectivity conservation. ▶

Similarly, in the fourth contribution, Stefan Marzelli and Harry Seybert, from ifuplan-Institut für Umweltplanung und Raumentwicklung and the Bavarian State Ministry of the Interior for Building and Transport respectively, look at the effects of the expansion of transport in and across the Alps on fragmentation of the landscape and ecological connectivity. With some 95 million overnight visits in the Alps, tourism is an important factor in defining the landscape, and Barbara Engels from the German Bundesamt für Naturschutz looks at the impacts in her contribution. While for the most part enhancing connectivity is viewed as a positive effect on biodiversity conservation, Jake Alexander and Christoph Kueffer from the ETH Zurich and HSR Rapperswil describe how connectivity promotes the spread of invasive species at global as well as landscape scales. Chris Walzer from the FIWI, similarly describes how changing the spatial structure of a landscape invariably also changes host-parasite abundance, distribution and persistence. Hunting is an often underestimated and neglected factor influencing the ecological connectivity of a landscape, and Fritz Reimoser examines the effect and the opportunities offered by wildlife and game management. Riccardo Santolini from the University of Urbino and his colleagues provide an Italian perspective and insights into the nexus of ecological connectivity and ecosystem services. Finally, Filippo Favilli from EURAC reviews and examines in detail the interconnection between agricultural development and the maintenance of an ecological continuum and biodiversity conservation.

3.1 Planning dynamic landscapes: Opportunities and limitations of spatial planning in creating ecological networks

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Ecological connectivity is a fundamental function of landscapes. Ecological connectivity provides open space for human activities and enables mobility and exchange between habitats for flora and fauna. Furthermore, the maintenance of connectivity in urbanised or human-exploited landscapes is one of the main goals of ecological networks and is included in national biodiversity strategies (for example France, Germany, Switzerland), or, in a more citizen-oriented sense, of green infrastructure (GI), as adopted by the EU (2013, see box 4).

Awareness of the significance of ecological connectivity (EC) and ecological networks (EN) when facing climate and land use change has grown in the last decade. EN (and GI) can be seen as the most recent concepts for nature protection and conservation of biodiversity. Advancing beyond approaches that focused on the protection of endangered or rare species (and their main habitats or biotopes) and the creation of spatially delimited nature reserves and protected areas (segregation), EN and GI aim to harmonise species habitats with human land use and presence (aggregation) and to enhance the connection between existing protected areas.

Various studies emphasise that conservation of biodiversity will need between 30 and 40 percent of the total territory. Within these areas biodiversity must be the priority in land use and management practices (for example in Switzerland: Guntern *et al.* 2013). For the Alpine area the required territory has been estimated to be as much as 40 percent. Since the nearly 1,000 nature reserves and other types of pre-existing protected areas currently cover approximately 25 percent of the territory of the Alpine Convention (ALPARC 2016), a further 10–15 percent of the surface must be protected in order to improve EC and EN. This proportion is inherently higher in areas with a lower percentage or density of nature reserves or protected areas.

3.1.1 Spatial planning: Biodiversity matters

Hence, biodiversity conservation is an important element in spatial planning and of relevance to the organisation of land use. Instruments of current spatial planning allow the definition of priority areas for biodiversity (such as Natura 2000, Important Bird Areas and more) , as far as they can be clearly delimited based on legally binding frameworks, such as ordinances, inventories, or property rights. This is mainly the case when designing nature reserves or protected areas, even if the priority setting in protection status ranges from "very strict" (nature reserves) to "recommended" (for example areas in regional parks).

Furthermore, spatial and especially landscape planning offer a large range of instruments for the co-ordination of multiple types of land uses and interests (including nature and landscape protection). These instruments aim to create a common alignment of spatial or landscape development while respecting varied interests. Experience has taught us that there are significant challenges in promoting and implementing nature and landscape protection. While economically relevant land use (infrastructure, production, urbanisation) can focus on specific areas, nature and landscape have to be considered trans-sectorally and often overlap with human land use. In land use planning, economically driven land use will usually secure the most suitable locations with optimal conditions in an unchallenged manner, while nature and landscape conservation entities are forced to defend most of their stated requirements. Therefore, it is crucial that evidence for biodiversity conservation and corresponding know-how be based on scientific research. This is also true for EN (and GI). In the successful introduction of EN (and GI) issues into in spatial planning, precise argumentation and the verification of social benefits are essential preconditions. In other words, basic understanding of EC and EN is the foundation for integrating ecological networks into spatial planning. Thus, scientific research as well as methodology and strategy development concerning EN (and GI) must be enhanced.

3.1.2 Top down or bottom up?

Regarding spatial planning, good instruments for the designation or delimitation of EN are rare. The most common method is to break down national or regional concepts, such as the Swiss national ecological network (REN; BAFU 2004) or Ecological Network of Isère Department (France; Conseil Général de l`Isère 2009), to the level of regional or municipal planning. The results of such top down approaches are, presently, not very promising, since the cascade down to the actual landowner in respect to legally-binding planning and implementation of measures is very slow. The break down is more efficient, when measures for the maintenance of ecological networks (such as green bridges) can be integrated in to urbanisation or infrastructure projects. To efficiently move forward on implementing EN measures, large-scale concepts (for example the Pan-European Ecological Network, the Green Belt, or Alpine Priority Conservation Areas), as initiated by the European Centre for Nature Conservation or the Continuum Initiative (see box 5) are needed. Top-down concepts help to focus action on the most important and promising areas.

On the other hand, bottom up planning on a local or regional level is often driven by feasibility or problems concerning specific species, and therefore often does not take into account the larger context. The integration of EN into local or regional planning can be supported by a systematic analysis of landscape connectivity, as proposed by JECAMI tool (*www.jecami.eu*). With tools like this, the wider landscape and habitat context and even long-term changes in landscapes can be addressed. The combination of landscape analysis tools with spatial planning tools must be further developed, following for instance the example of systematic conservation planning in the Netherlands.

3.1.3 Structural or functional connectivity?

Ecological connectivity can be regarded from a structural or from a functional perspective. Structural connectivity describes the shape, size and location of features in the landscape (Brooks 2003). Functional connectivity entails the extent to which a species or population can move among landscape elements in a mosaic of habitat types (Hilty *et al.* 2006). Structural connectivity meshes better with spatial planning, as features in the landscape can be selected in a land use system, while interrelations between habitats are vastly more difficult to define and delineate. For this reason, structural connectivity should be the first consideration in spatial planning processes. Nonetheless, functional connectivity has to be considered, when specific requirements of important species (isolation or dissection of relevant habitats) are concerned, and landscape dynamics are changing the mosaic of habitats.

These statements are mainly valid for terrestrial connectivity. Aquatic and aerial connectivity are often forgotten in spatial planning. While water-courses are regulated by specific laws, the aerial (third) dimension is widely neglected in spatial and landscape planning. Specific efforts will be needed to integrate these aspects into future EN planning.

3.1.4 Control or dynamic?

Many species or communities of flora and fauna are sensitive to changing conditions, such as those caused by urbanisation, land use change, habitat fragmentation, or climate change. Flexibility in the use of habitat patches (for example dislocation to new

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habitat elements) is crucial for adaptation to such changes. However, instruments for spatial planning have been designed primarily to define and control land use and spatial development. Dealing with EN issues, spatial planning tends to statically fix spatial structures or corridors in a present-day given state, without considering landscape dynamics and the necessary flexibility in habitat use for flora and fauna. Furthermore, GI as defined by EU (see box 4) represents such a method of locating spatial structures of natural and semi-natural areas in a given land use context. Practically, instruments for land use planning are hardly appropriate to manage change with regard to EN or GI. One of the main challenges when integrating EN into spatial planning will be to develop concepts for multi-functional land use (for example by defining land use types in the interest of biodiversity) and new tools for adaptive land management.

3.1.5 Connect administrations and sectors

Spatial planning faces a central challenge in trying to assure ecological or landscape connectivity. A second and even more challenging task within spatial planning is connecting the multiple land users involved in the various sectors of administration and among different territories with specific competences and given boundaries. As EN must be planned beyond such present-day legal and administrative frameworks, the main task is often to begin by addressing socio-political issues in order to ascertain how to establish EN or how to organise elements of these networks. Connecting people from different administrations or sectors and addressing EN enhances the likelihood of success in spatial planning, as long as it is possible to overcome sectoral and territorial borders. Awareness concerning the needs and benefits of connectivity in spatial development must be raised within all concerned target groups, and this must extend beyond the basic concept of nature protection. Such campaigns based on scientific evidence are important to attract necessary partners and involve them in the planning processes.

3.1.6 Conclusion

Instruments for spatial and landscape planning allow for the consideration of ecological networks but only on quite large scales and/or with low legally binding character. Moreover, spatial planning currently limits the scope of decisions favouring ecological networks in several ways: land use planning follows the principle of segregation and rarely encourages multiple use plans that include biodiversity; and the differentiation of planning authorities (multi-level governance) often hinders cross-border planning, which is needed when planning ecological networks. In the future, the needs for planning ecological networks have the potential to develop instruments for more trans-sectoral, more cross-border, more dynamic and more integrative practices in spatial planning.

Box 4: Green Infrastructure

Green Infrastructure addresses the spatial structure of natural and semi-natural areas as well as other environmental features that enable citizens to benefit from its multiple services. The underlying principle of Green Infrastructure is that the same area of land can frequently offer multiple benefits if its ecosystems are in a healthy state. Green Infrastructure investments are generally characterised by a high level of return over time, they provide job opportunities, and they can be a cost-effective alternative or be complementary to 'grey' infrastructure and intensive land use change. GI serves the interests of both people and nature. Source: *www.ec.europa.eu/environment/nature/ecosystems/index_en.htm*