

INTERACTION BETWEEN POLICY CONCERNING SPATIAL PLANNING AND ECOLOGICAL NETWORKS IN EUROPE

Overview Report

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0. Summary

This overview introduces the relationship between ecological networks and spatial planning. The origins, characteristics and development of the ecological network model are discussed, including the most important variations, and the key features of ecological networks that are relevant to spatial planning are discussed. The European dimension of spatial planning is described and the interactions between ecological networks and spatial planning are summarised. Various European approaches to ecological networks in relation to spatial planning are ordered and each approach is illustrated with examples.

1 The Spatial Dimension of Ecological Networks

1.1 The Ecological Network Model

The ecological network model has been developed over the past 35 years with the goal of conserving biodiversity through maintaining and strengthening the integrity of ecological and environmental processes. As a conservation approach, ecological networks are characterised by two generic objectives, namely: (1) maintaining the functioning of ecosystems as a means of facilitating the conservation of species and habitats and (2) promoting the sustainable use of natural resources in order to reduce the impacts of human activities on biodiversity and/or to increase the biodiversity value of man-managed landscapes (Bennett and Wit, 2001).

In applying this approach, ecological networks share five common features (Bennett and Mulongoy, 2006):

- a focus on conserving biodiversity at the landscape or ecosystem scale
- an emphasis on maintaining or strengthening ecological coherence, primarily through providing for connectivity
- ensuring that critical areas are buffered from the effects of potentially damaging external activities
- restoring where appropriate degraded ecosystems
- promoting the sustainable use of natural resources in areas of importance to biodiversity conservation.

Before discussing ecological networks in more detail, it is important to understand that terminology varies from region to region and from language to language. The term “ecological network” evolved in Europe in various language equivalents in the early 1990s and has been used in the most important international fora in recent years, including IUCN’s World Conservation Congresses, the World Summit on Sustainable Development’s Plan of Implementation and the CBD Conferences of the Parties, including the Programme of Work on Protected Areas. In regional and national settings, however, different terms are often used to describe the model. These include “territorial system of ecological stability”, “reserve

network”, “bioregional planning”, “connectivity conservation areas” and various language-specific variants, but also – particularly in Latin America – “corridor”.

1.2 Methodological Variations

Although ecological networks share a common architecture, their development has been characterised by a process analogous to convergent evolution. Two broad evolutionary paths can be distinguished. In Central and Eastern Europe, several national ecological network programmes were developed using the polarised-landscape theory of the Russian geographer Boris Rodoman (Rodoman, 1974). His “eco-stabilising” approach infers that the landscape should be zoned in such a way that intensively used areas are balanced by natural zones that function as a coherent, self-regulating whole. The resulting programmes not only developed the first ecological networks but also integrated biodiversity conservation into broad environmental management plans, approximating to what would now be described as national sustainable-development strategies.

The first initiative to establish what is now recognised as an ecological network was the Estonian Network of Ecologically Compensating Areas (Külvick, 2002). This programme originated as a concept in the mid-1970s and was elaborated into a national proposal in 1983. Following this initiative, several other countries in the region developed similar proposals, most notably Lithuania and former Czechoslovakia. All these programmes were characterised by an integrated approach to land-use zoning and environmental management within a national development-planning system.

In contrast to Central and Eastern Europe, the stimulus that led to the ecological network model in most other regions came primarily from developments in ecological theory, in particular MacArthur and Wilson’s equilibrium theory of island biogeography and metapopulation theory (MacArthur and Wilson, 1967; Gilpin and Hanski, 1991). The most important insight that followed from these theories was that habitat fragmentation increases the vulnerability of species populations by reducing the area of habitat available to local populations and limiting the opportunities for dispersal, migration and genetic exchange.

The realisation that island biogeography and the concept of metapopulations offered important lessons for biodiversity conservation was given practical form in the mid-1970s when Jared Diamond and others proposed general rules for the configuration of nature reserves (Diamond, 1975). In simple terms, these rules stated that nature reserves should be as large as possible, as round as possible (in order to reduce damaging edge effects), as close as possible to each other, and as far as possible connected with each other. The impact of these rules was increased when the principles were included in IUCN’s World Conservation Strategy (IUCN, 1980; see also Figure 1.1).

Following these developments, interest grew in Western Europe, North America, Latin America, Australia and Asia in developing conservation approaches that promoted ecological coherence at the landscape scale. In Western Europe, the concept of wildlife corridors was introduced into regional planning in Denmark, and in 1990 the Dutch government adopted a plan for a national ecological network. These programmes led in turn to the endorsement in 1995 by over 50 countries of the Pan-European Biological and Landscape Diversity Strategy that included a commitment to establish the Pan-European Ecological Network (see Bonnin et al., 2007). In recent years several indicative maps have been prepared that delineate the

provisional spatial configuration of the Pan-European Ecological Network (Bouwma et al., 2002; Biró et al., 2006; Jongman et al., 2006)¹.

1.3 Related Approaches

The principles that underly the ecological network model can be found in part in several other established approaches to biodiversity conservation. The oldest of these is the UNESCO Biosphere Reserve. The Biosphere Reserve model was launched by UNESCO as part of its 1974 Man and Biosphere Programme (UNESCO, 1974). This programme recognised the need to reconcile the conservation of areas that host valuable biodiversity with local land-use needs through the delineation of core areas, buffer zones and transition areas (see Figure 1.2). Land use in a buffer zone is restricted to activities that are compatible with the protection of the core area, while in a transition area (which today might also be called a sustainable-use area) appropriate economic activities are permitted and sustainable resource management practices can be developed.

A conservation model that is related to the ecological network is the Ecosystem Approach. The Ecosystem Approach can be regarded as a strategy for the management of land, water and living resources that promotes biodiversity conservation and sustainable use in an equitable way (see, for example, Smith and Maltby, 2003). In essence, the Ecosystem Approach is a framework for holistic decision-making and action. Applying the Ecosystem Approach is prescribed by 12 principles and five points of operational guidance (see box). These show a high level of correspondence with the characteristics of the ecological network model: both focus on maintaining ecosystem functions in the long term and securing the sustainable use of land, although the Ecosystem Approach gives greater emphasis to the management process. The way in which the two models have evolved has nevertheless resulted in certain differences in emphasis and application. Ecological networks evolved as national or regional responses to the challenges of biodiversity conservation and sustainable development, in many cases with little knowledge of comparable approaches elsewhere. As a result, ecological networks display a variety of methodological approaches and management philosophies. But despite this diversity they have arrived – often independently – at a common model of how the two challenges can best be met.

By contrast, the Ecosystem Approach was developed in the 1990s through a broad-based, globally organised process and therefore operates through generally applicable management principles which are intended to allow some scope for elaboration in order to take account of local and regional circumstances. In 1995 the CBD's Second Conference of the Parties decided that the Ecosystem Approach should be the primary framework of action to be taken under the Convention (Decision II/8). In 2000 the Fifth Conference of the Parties recommended its application and requested the Subsidiary Body on Scientific, Technical and Technological Advice (SBSTTA) to review the principles and guidelines (Decision V/6). The

¹ The development of a European Ecological Network forms one of the priorities and activities of European nature conservation under the Pan-European Biological and Landscape Diversity Strategy (PEBLDS) which was endorsed by 54 European countries in Sofia, in 1995. The 2003 Kyiv Resolution on Biodiversity, endorsed at the Fifth 'Environment for Europe' Ministerial Conference, sets 2006 as a target date for preparing indicative maps for all regions of Europe. It was envisaged that PEEN should be based on existing initiatives and European directives, its backbone being Natura 2000 (comprising Special Protection Areas under the Birds Directive and Special Areas of Conservation under the Habitats Directive) and the Emerald Network. Thus, Article 10 of the 1995 Habitats Directive, specifically relates to land-use planning, the development of policies and the exploration of possibilities for improving ecological coherence between sites designated under the directive, and provides further strong direction for EU Member States

SBSTTA subsequently recommended that the Conference of the Parties should give priority to promoting its implementation (Subsidiary Body on Scientific, Technical and Technological Advice, 2003) and the Seventh Conference of the Parties agreed that priority should be given to facilitating the implementation of the Ecosystem Approach as the primary framework for addressing the three objectives of the Convention in a balanced way (Decision VII/11).

More recently, WWF has developed its own approach to biodiversity conservation that closely resembles the ecological network model: Ecoregion-Based Conservation (ERBC). ERBC was developed in the late 1990s to frame conservation action at the ecoregion level – that is, relatively large units of land or water that harbour a characteristic set of species, communities, dynamics and environmental conditions. The approach aims to achieve four fundamental conservation goals (World Wide Fund for Nature, 2000):

- representation of all distinct natural communities
- maintenance of ecological and evolutionary processes
- maintenance of viable populations of species
- resiliency in the face of large-scale periodic disturbances and long-term change.

WWF has identified 867 terrestrial ecoregions worldwide as well as freshwater and marine ecoregions. It has included the 238 ecoregions most crucial to the conservation of global biodiversity in its Global 200 Programme. Following the preparation of the programme, WWF initiated a large number of ERBC projects with the aim of conserving biodiversity in these regions. The approach corresponds in many respects to the ecological network model and the Ecosystem Approach in that the aim is to maintain ecological functions at the ecosystem scale, though the primary emphasis is on the process management that is required to achieve this objective.

Finally, it should be noted that the 1992 Habitats Directive is in the process of establishing an EU-wide representative system of protected areas under the name Natura 2000. This Directive, together with the earlier Birds Directive, explicitly recognises the value of ecological coherence and connectivity and therefore has the potential to evolve towards a network-like model. The Emerald Network that is being developed under the 1979 Bern Convention extends this approach to non-EU European states. (See Chapter 2 for a further discussion of Natura 2000 and the Emerald Network in relation to ecological networks.)

1.4 Spatial Aspects of Ecological Networks

Ecological networks share not only common conservation objectives and operational features but also a characteristic spatial architecture. This architecture is a derivation of spatial relationships and processes that are key to biodiversity conservation, particularly the distribution of local species populations, the arrangement of habitats, geographical processes and human activities. Specific functions are allocated to different areas depending on their respective ecological value and natural-resource potential (Bennett, 2004). These functions are reflected in a coherent system of components:

- **Core areas**, where the conservation of biodiversity takes primary importance, even if the area is not legally protected. The primary objective of core areas is to ensure the conservation of a representative array of characteristic habitats and species populations.
- **Corridors**, which serve to conserve vital ecological or environmental interactions by maintaining connectivity between the core areas where necessary. These linkages may be of three broad kinds:

- linear corridors in the form of landscape elements such as hedges, shelterbelts, woods and rivers or infrastructure such as tunnels and ecoducts that allow species to traverse an obstacle)
- “stepping stones”, that is, an array of small patches of habitat that individuals use during movement for shelter, feeding, resting and other ecological functions
- various forms of interlinked landscape matrices, usually in the form of extensively managed landscapes, that retain sufficient natural elements to allow individuals to survive during movement between habitat patches.
- **Buffer zones**, which insulate areas where biodiversity conservation is the primary objective from potentially damaging external influences, and particularly those caused by inappropriate forms of land use. This function therefore permits in principle a range of sustainable human activities.
- **Sustainable use areas**, which may surround the network and where opportunities are exploited within the landscape mozaic for the sustainable use of natural resources together with the maintenance of most ecosystem services.

A diagrammatic representation of this spatial arrangement is shown in Figure 1.3.

1.5 Other Issues

Scale

One of the most interesting aspects of the ecological network model is the variety of scales at which it is being applied. Many ecological networks encompass a geographical region, such as a watershed, a mountain range or a biome, e.g. temperate broad-leaf forest. However, where the ecological network is part of government policy or planning, the region may be delineated by a sub-national administrative unit, by an entire country or even by a transboundary political region, such as the TEN programme initiated by regional authorities in East Anglia, the northern Netherlands, northern Germany and southern Denmark with Interreg funding. Thus, at one extreme ecological networks are being developed as detailed conservation plans at the local level, such as several recent initiatives by nature conservation organisations in the UK (see, for example, Lincolnshire Wildlife Trust, 2006). At the other extreme are instances where the model has been used as the basis for a strategic approach to biodiversity conservation at the supra-continental scale, such as the Pan-European Biological and Landscape Diversity Strategy for the Europe-Northern Eurasian region and the Western Hemisphere Shorebird Reserve Network.

Biodiversity Focus

Instead of aiming to conserve an entire ecosystem or community, some ecological networks give primary emphasis to the conservation of a single flagship species or a group of threatened species. Examples include the Italian National Ecological Network (REN) (Boitani et al., 2003) that focuses on vertebrate species, the various flyway programmes for migratory bird species (see Boere and Rubec, 2002) and the Bonn Convention agreements and memoranda of understanding on the conservation of threatened migratory species such as European bats and the slender-billed curlew (Bennett, 2003). However, it is still appropriate to class these programmes as ecological networks since they apply the same basic conservation principles and aim to conserve the habitat, ecological communities and environmental conditions on which the respective species populations depend.

Approaches to Development and Implementation

Most of the ecological network programmes in Europe are being developed and implemented primarily through government programmes, whether international, national or regional. Only a relatively small number – such as WWF’s ecoregion projects – are driven by NGOs. (It is interesting to note that in some other regions, particularly North and South America, by far the majority of the ecological network programmes are NGO initiatives.) An important distinction between the two classes of programme is the types of instrument that are applied to implement each kind of programme. Government programmes invariably rely to an important extent for their realisation on policy instruments such as legislation, spatial planning and economic incentives (including land purchase). Instruments such as stakeholder negotiation, awareness-raising and private action, while important in securing broader support for the programmes, do not play the primary role in implementing ecological networks on the ground. NGOs, by contrast, cannot exercise the legislative and budgetary power that is available to governments and are therefore forced to rely primarily on citizen support, stakeholder processes and private action (although some of the larger NGOs can invest substantial financial resources in their projects or even purchase extensive tracts of land; most NGO-driven ecological network programmes also aim to secure new government biodiversity-conservation policies).

2 Interaction Between Ecological Networks and Spatial Planning

Spatial development in Europe is increasingly shaped by forces that operate across national boundaries. This is obviously the case in an increasingly globalised economy, but it also applies to other areas that are of European concern, such as social cohesion and the management of natural resources. As a result, the EU has progressively developed its policy influence in a wide range of fields – most obviously the environment where transboundary processes are particularly important.

It could be argued that spatial planning is a prime example of a sector that should become increasingly international in focus and organisation in response to the need to strengthen the management of transboundary processes. However, spatial planning policies have traditionally been developed at the national, regional and local levels. And despite the radical internationalisation and integration of policy-making in Europe that has been brought about through the rise of the European Union, very little has changed in the organisation of spatial planning.

This disparity has been the subject of considerable debate in recent decades, and it has also stimulated a range of initiatives that have the broad aim of strengthening European policy capacity to manage transboundary processes and the planning response. As long ago as 1961 the Consultative Assembly of the Council of Europe promoted the concept of a European regional development policy, which it regarded as one of the prime political tasks for European institutions. In 1970 the Council of Europe hosted the first European Conference of Ministers Responsible for Regional Planning (CEMAT). Successive conferences produced a range of cooperative initiatives, including the European Charter of Regional Planning, adopted in Torremolinos in 1983, and the European Regional Planning Strategy, adopted in Lausanne in 1988. The Torremolinos Charter even stated that the regional level was “the most appropriate level at which to pursue a regional/spatial planning policy”, emphasising the need for “coordination between the regional authorities themselves and local and national

authorities as well as between regions of neighbouring countries". This work was further pursued in the EU through a series of initiatives by the Member State ministers responsible for spatial planning that included the Europe 2000 report (1991), the European Spatial Development Perspective (1999), the establishment of the European Spatial Planning Observation Network (ESPON) with the aim of supporting policy development and building a European scientific community in the field of territorial development, and the recent Territorial Agenda (2007).

Since spatial planning is concerned with the achievement of economic, social, cultural and environmental objectives through optimising the organisation of spatial functions, there is clearly a potentially close relationship between the development of ecological networks and spatial planning. Three main facets of this interaction can be distinguished:

- **Balancing biodiversity conservation with other objectives**

Both spatial planning and ecological networks aim to balance biodiversity conservation with other objectives. However, whereas spatial planning aims to optimise a wide range of functions and land uses, including biodiversity, ecological networks give primacy to achieving biodiversity conservation objectives. Other functions are therefore in principle subordinate but are permitted to the extent that they are compatible with biodiversity conservation requirements. The reasoning is that, by conserving and interconnecting an array of functionally related sites, the whole becomes greater than the sum of the parts. But in practice, because ecological networks are applied to landscapes that also serve other functions which may also have a high economic, social or cultural value, trade-offs between biodiversity conservation and other subordinate objectives are far from straightforward. Moreover, as this study will show, the concepts and methods applied in the various regions lead to wide variations in the way in which the range of objectives are balanced and to important differences in the interaction between ecological networks and spatial planning.

- **Organisational arrangements**

Although the operational scope of spatial planning and ecological networks is partially shared, in most regions they are separately organised. Thus, whereas spatial planning always operates under a clear governmental competence, ecological network programmes are organised in a wide range of forms and operate within various constituencies, both public and private: many ecological networks, for example, are initiated by NGOs or independent research institutes. Spatial planning is also characterised by a common administrative hierarchy, from national policies and strategic plans – including sectoral plans such as in the fields of economic development, transport and water management – through regional structure plans to local development plans. Various EU initiatives also operate to some degree through the spatial planning process, even though spatial planning is not a formal EU competence. In contrast, ecological networks vary widely in scale and organisational structure, from local to intercontinental and from detailed and prescriptive to conceptual and strategic. As the study will demonstrate, these differences in organisational form have important implications for the interaction between ecological networks and spatial planning.

- **Methods of achieving objectives**

Apart from the interactions that follow from shared objectives and operational processes, spatial planning and ecological networks also apply various methodologies that reflect particular concepts or specific tasks but which to some extent share a common *raison*

d'être, namely the need to synthesise and order a wide range of economic, social, geographical and environmental information as a means to devising an optimum outcome. For example, the working approach may be process- or goal-oriented (that is, the emphasis may be on securing agreement between stakeholders or on achieving a particular result) and it may be sectoral or integrative (by focusing exclusively on a particular sector, such as transport, or taking an inclusive approach to dealing with a broad issue, such as sustainable development). Depending on the approach adopted, a wide palette of methods and techniques are available. These include decision-making techniques, simulation and quantitative methods, scheduling techniques, graphical representation in projects, planning information systems, habitat and species mapping, population dynamics, land-use mapping, GIS, implementing instruments and monitoring and evaluation methods. The study will highlight the way in which a range of instruments are applied in spatial planning and ecological network programmes, many of which are shared.

However, in addition to these three areas, a further dimension to the interactions between ecological networks and spatial planning is of importance, namely the changing spatial-planning and biodiversity-conservation environments. In many European countries, certain frameworks for biodiversity conservation and spatial planning have changed radically over the past decade as a result of this increasing dynamism. Thus, the increase in the mobility of individuals and economic activities and the concept of the network society (Castell, 1996), in which networks replace hierarchised and circumscribed relationships, are reflected in the way in which social and economic relations are increasingly stretched across space: while the relevance of proximity has diminished, the importance of “connectivity” has grown – which provides an interesting parallel to developments in biodiversity conservation. Indeed, biodiversity conservation in many regions around the world has witnessed a comparable revolution over the past decades as the traditional concept of protected areas has begun to evolve in order to meet new challenges. These developments have been elegantly summarised by Phillips (Table 1.1):

	AS IT WAS Protected Areas Were:	AS IT IS BECOMING Protected Areas Are:
Objectives	<ul style="list-style-type: none"> – Set aside for conservation – Established mainly for spectacular wildlife and scenic protection – Managed mainly for visitors and tourists – Valued as wilderness – About protection 	<ul style="list-style-type: none"> – Run also with social and economic objectives – Often set up for scientific, economic and cultural reasons – Managed with local people more in mind – Valued for the cultural importance of “wilderness” – Also about restoration and rehabilitation
Governance	<ul style="list-style-type: none"> – Run by central government 	<ul style="list-style-type: none"> – Run by many partners
Local people	<ul style="list-style-type: none"> – Planned and managed against people – Managed without regard to local opinions 	<ul style="list-style-type: none"> – Run with, for, and in some cases by local people – Managed to meet the needs of local people
Wider context	<ul style="list-style-type: none"> – Developed separately – Managed as “islands” 	<ul style="list-style-type: none"> – Planned as part of national, regional and international systems – Developed as “networks” (strictly protected areas, buffered and linked by green corridors)
Perceptions	<ul style="list-style-type: none"> – Viewed primarily as a national asset – Viewed only as a national concern 	<ul style="list-style-type: none"> – Viewed also as a community asset – Viewed also as an international concern
Management techniques	<ul style="list-style-type: none"> – Managed reactively within short timescale 	<ul style="list-style-type: none"> – Managed adaptively in long-term perspective – Managed with political considerations

	– Managed in a technocratic way	
Finance	– Paid for by taxpayer	– Paid for from many sources
Management skills	– Managed by scientists and natural resource experts – Expert led	– Managed by multi-skilled individuals – Drawing on local knowledge

Table 1.1. The changing paradigm of protected areas (taken from Phillips, 2003).

An obvious manifestation of the more dynamic economic development, demographic shift, social evolution and cultural change is the increasing competition for space in European countries. The demand for spatial functions has increased substantially in both quantitative and the qualitative terms, whereby regional development has now become a process of actively engineering scarce space to create the “places” that meet the changing and intensifying requirements for living, working or recreating while still providing sufficient environmental stability to meet the demands of ecosystems and cultural heritage. This tension has been increasing for several decades in the advanced industrial countries and is becoming more apparent in the transition economies².

At the same time, the increasing demand among economic actors and civil society for influence in shaping the spatial environment has led to greater stakeholder involvement in the decision-making processes. Spatial planning and ecological network programmes in some European countries have therefore increasingly actively sought the involvement of a wide range of stakeholders: municipalities, regional political authorities, developers, investors, environmental and other NGOs, public utilities, business, education, religious organisations and individual citizens. Indeed, in many cases planning procedures have become highly complex and process-heavy, with the result that efforts are increasingly being devoted to simplifying the procedures and increasing the efficiency of the decision-making while still trying to safeguard legitimacy.

3 European Approaches to Ecological Networks in Relation to Spatial Planning

Current ecological network programmes in Europe are by no means consistent in the way in which they have been initiated, in their organisational form, in their instrumental choice or in the way they interact with spatial planning. In classifying ecological network programmes in terms of their structural relation to spatial planning, three basic characteristics are of importance:

- the scale of the programme, and specifically whether it is international, national or sub-national in scope
- whether the programme is driven by a government or a non-governmental actor such as an NGO or a research institute, since this will determine the direct potential for incorporating the ecological network into the spatial planning system
- whether the programme is legislatively binding or non-binding, since this will establish the degree of discretion in taking implementing measures and the type of measures that can or must be taken by government authorities.

² What has also become clear is that the serious and continuing loss to Europe’s biodiversity is a reflection of the ongoing decline in the ability of ecosystems to sustain their natural production capacity and to perform regulating functions. The concept of ecosystem services has raised a number of new issues and has the potential to create a new ‘paradigm’ in relation to environmental and biodiversity policy, of which spatial planning is likely to be a major component

Using these criteria, ecological network programmes in Europe can be grouped as follows:

1. International, multilateral or bilateral governmental agreements on ecological networks, such as:
 - Pan-European Ecological Network
 - the Bonn Convention agreements and memoranda of understanding.These agreements fall under international law and strictly speaking are not binding in the way that national legislation or EU directives and regulations are legally binding and enforceable.
2. National legislation that formally requires the development of ecological networks, for example in:
 - Germany (to be implemented by the states)
 - Czech Republic and Slovakia (originally adopted when they were united as Czechoslovakia)
 - Hungary
 - Ukraine
 - Moldova.
3. National policies that infer the development of ecological networks, such as in:
 - Netherlands
 - Switzerland
 - Estonia
 - Latvia
 - Lithuania
 - Romania.
4. Ecological network programmes initiated by lower government authorities, for example:
 - Russian Federation (republics, regional governments and municipalities)
 - TEN (lower authorities in UK, Netherlands, Germany and Denmark)
 - RENPA (Andalusia Autonomous Region, Spain).These programmes are not legally binding.
5. Ecological network programmes initiated by NGOs or independent research institutes (international, national or regional/local), such as:
 - international: European Green Belt (22 countries along the former Iron Curtain, coordinated by IUCN); Sava River Ecological Network (research institutes in Slovenia, Croatia, Bosnia, Herzegovina and Serbia and Montenegro, plus IUCN and the International Agricultural Centre, Netherlands)
 - national: ECONET – Poland (IUCN); Nature Network (Denmark, initiated by the Danish Society for Nature Conservation)
 - regional: Planeco Project (central Appenines, Italy, initiated by the University of Aquila); Heart of Russia (Central Russian Plain, initiated by the Biodiversity Conservation Center).

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