

Connectivity Conservation:
*International Experience in Planning,
Establishment and Management
of Biodiversity Corridors*



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Cover photo: WWF. Truong Son in the Annamite Range.

Acronyms

A2A	Alps to Atherton Initiative, Australia
ADB	Asian Development Bank
BCI	Biodiversity Conservation Corridor Initiative
CBD	Convention on Biological Diversity
CEL	IUCN Commission on Environmental Law
IUCN	The World Conservation Union
NGO	Non-governmental organization
WCPA	IUCN World Commission on Protected Areas
WWF	World Wide Fund for Nature
Y2Y	Yellowstone to Yukon Conservation Initiative, Canada and United States

1. Introduction

In recognition of the crucial role that corridors can play in biodiversity conservation across national borders as well as within national boundaries, the Government of Viet Nam through the Ministry of Natural Resources and Environment has agreed with the Asian Development Bank (ADB) that efforts under the Core Environment Program – Biodiversity Conservation Corridor Initiative (BCI) Phase 1 – should include development of a Decree to promulgate regulations on biodiversity corridors, and that the World Conservation Union (IUCN) would provide technical input on protected areas and biodiversity corridors. IUCN's input will include:

- this background paper on legal instruments governing biodiversity corridors and practical experience with biodiversity corridors in other countries;
- a background paper on national legal instruments that govern aspects of biodiversity corridors in Vietnam; and
- a draft of the Decree to promulgate regulations governing the management of biodiversity corridors in Vietnam.

This background paper surveys international experience in the development and use of mechanisms to establish and manage connectivity conservation. Specifically it seeks to provide an understanding of the range of mechanisms including laws, regulations, and other regulatory instruments and agreements which have been used in other countries to support connectivity conservation. The information in this background paper will enable practitioners in Viet Nam to understand what other countries have learned from experience with connectivity conservation and to adapt approaches to the national context. This review draws upon examples and case studies from the literature and from the knowledge of experts in IUCN's technical networks.

2. Biodiversity Corridors and Connectivity

Connectivity conservation involves the protection, retention and rehabilitation of natural connections among habitats within ecosystems at the landscape level. The term "landscape" as used in this context means "an area, as perceived by people, whose character is the result of the action and interaction of natural and/or human factors" (European Landscape Convention 2004).

Internationally, concepts aimed at maintaining and restoring ecosystem integrity have been undergoing rapid development over the last 30 years. Ecological networks, corridors and buffer zones have been increasingly deployed as mechanisms to support strengthened environmental linkages in the land and seascape. Whilst a myriad of different terminologies and approaches have evolved around the world, the central premise of connectivity conservation has perhaps best been expressed at a recent international workshop on conservation connectivity held in Papallacta, Ecuador:

"The maintenance and restoration of ecosystem integrity requires landscape-scale conservation. This can be achieved through systems of core protected areas that are functionally linked and buffered in ways that maintain ecosystem processes and allow species to survive and move, thus ensuring that populations are viable and that ecosystems and people are able to adapt to land transformation and climate change. We call this proactive, holistic, and long-term approach connectivity conservation."

Papallacta Declaration (2006)

Biodiversity conservation corridors are a physical expression of conservation connectivity. They are defined as areas of suitable habitat that provide functional linkages between

protected areas. They have three main functions: (1) conserving habitat for species movement and for the maintenance of viable populations (2) conserving and enhancing ecosystem services, and (3) promoting and enhancing local community welfare through the conservation and use of natural resources (ADB/BCI 2005).

2.1 Why Biodiversity Corridors?

Habitat loss and fragmentation are the main threats to biodiversity. With agricultural expansion, infrastructure development, urbanization, logging, and mining, natural habitats are shrinking to islands surrounded by modified landscapes. While protected areas have a role to play in maintaining biodiversity, there is widespread recognition that protected areas are inadequate in themselves for securing biodiversity for the long term. Many species (especially wide-ranging ones) are confined to isolated areas too small to allow them to find adequate food, water, mates, or refuge from predators. As habitats continue to degrade, fragment and become more isolated, local extinction rates accelerate and there is an increase in the probability of extinction due to catastrophic events and inbreeding. Climate change is accelerating habitat fragmentation and the vulnerability of both floral and faunal communities.

The use of conservation corridors between protected areas offers a way of improving connections between habitats. Corridors provide land or water pathways that link protected areas with one another, allow plants and animals to disperse and migrate, and adapt to the pressures of changing climate and habitat conditions. Corridors can therefore facilitate ecosystem dynamics through the flow of resources and energy and through accommodating the complex interrelated processes of ecological systems. Corridors can include areas that are under private as well as public management.

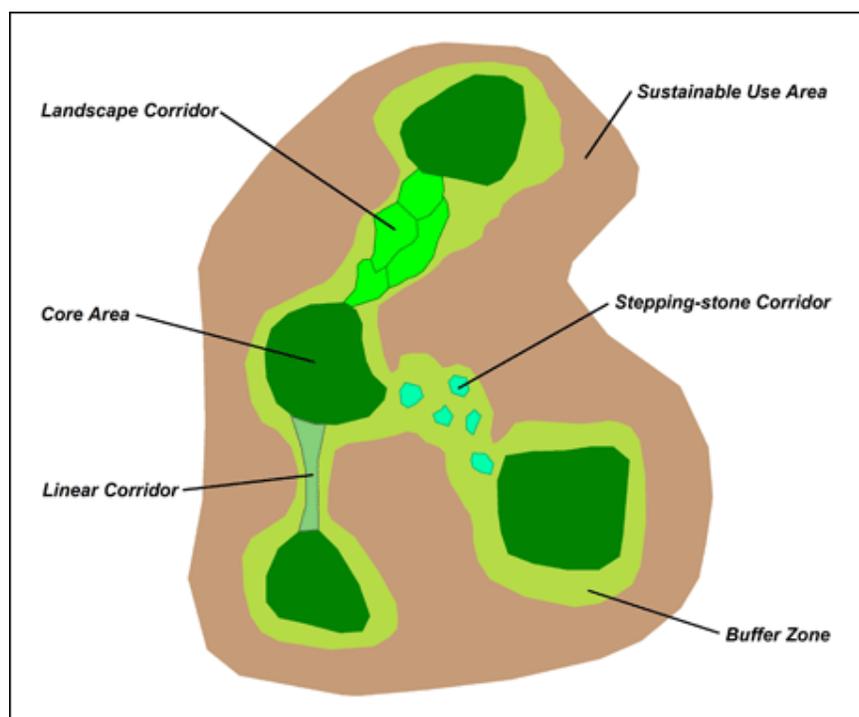
2.2 Types of Corridors

In order to restore or improve connectivity, corridors can take different forms (see Figure 1):

- linear corridors – which can be narrow (e.g., 40-80 meters wide) yet still provide connectivity between habitat fragments for target species. Some examples of linear corridors include narrow corridors of natural vegetation connecting forest plantations and “ecoducts” (land bridges planted with grass and hedgerows) that enable animals to cross a motorway that cuts through a forest;
- stepping stones – small patches of habitat that can be used during movement for shelter, feeding and resting within a landscape in which other activities (such as agriculture and activities permitted in buffer zones) are taking place. For example stepping stones which provide a network of habitat refuges have been found to be effective in enabling the recolonization of the silver spotted skipper butterfly in England (Bennett 2004);
- landscape corridors – a mosaic of contiguous natural cover that allows movement between habitat patches or protected areas. The Mesoamerican Biological Corridor, for example, one of the earliest corridor initiatives, contains landscape corridors that link clusters of protected areas. The land use in many of the Mesoamerican corridors includes not only natural or restored areas but also areas under human use, especially agriculture.

Corridors can also range in size from relatively small urban corridors to national and regional corridor programmes that encompass millions of hectares of lands.

Figure 1: Types of Biodiversity Corridors



From: Biodiversity Conservation Corridor Initiative
<http://www.adb.org/Projects/core-environment-program/why.asp>

3. International Experience

Interest in restoring ecological integrity has been growing over the past 30 years particularly through the establishment of transboundary protected areas. However, most of the recent initiatives specific to improving biodiversity connectivity date from the early 1990s. Establishment of ecological networks and biodiversity corridors in countries around the world has accelerated since 2000. A March 2006 global assessment identified the establishment of 200 ecological network/corridor programmes, 26 migratory bird flyways and 188 transboundary complexes all attesting to this growing interest (Bennett and Mulongoy 2006).

The earliest laws enabling biodiversity corridors that this study identified were adopted in 1996. Since 2000, at least nine countries have enacted legislation enabling biodiversity corridors at national or sub-national level.

3.1 International Agreements

A growing number of international agreements and targets now call for the adoption of landscape- and seascape-level conservation efforts to provide a more comprehensive strategy for biodiversity conservation to underpin development

The creation of biosphere reserves, conceived in 1974 under the Man and the Biosphere Programme of the United Nations Educational, Scientific and Cultural Organization is one of the earliest initiatives to target the ecological, social and economic dimensions of biodiversity loss and how to reduce it. Since 1974 more than 480 biosphere reserves have been created in more than 100 countries. Today, biosphere reserves may form part of biodiversity corridors. The 1979 Convention on Migratory Species and especially the

provisions of agreements that have been entered into to conserve particular species, establish a framework for maintaining a network of suitable habitats related to migration routes.

The Convention on Biological Diversity (CBD) adopts the ecosystem approach in calling for the integrated management of land, water and living resources in such a way to promote conservation and equitable sustainable use. Two of the 12 guiding principles for the ecosystem approach place special emphasis on the importance of corridors and connectivity through the conservation of ecosystem structure and functioning to maintain ecosystem services and through adopting appropriate spatial and temporal scales (CBD 2000). Many of the CBD Programmes of Work, including the Programme of Work on Protected Areas, call for improved conservation connectivity. In addition, the Plan of Implementation adopted at the 2002 World Summit on Sustainable Development gives prominence to promoting the development of national and regional ecological networks and corridors in order to achieve the 2010 biodiversity targets.

A diversity of approaches has been taken around the world to enable the planning, establishment and management of biodiversity corridors and other forms of connectivity.

3.2 Regional Experience

The matrix attached as Annex 1 summarizes available information and comparative experience with connectivity and biodiversity corridors around the world. It lists known connectivity initiatives and provides references to the legal instruments or other mechanisms that enable and govern them, and references to reports on experience with them where that information is available. The matrix is very much a work in progress. Where information on legal instruments is unavailable – or at least unavailable in English, French or Spanish, IUCN's official languages – the names of known corridors have simply been listed to facilitate updating the matrix in the future.

Many countries have directed their efforts to improve connectivity conservation by establishing transboundary conservation areas. While transboundary initiatives have certainly improved connectivity, it is not always the primary reason for establishing transboundary protected areas.

3.2.1 Asia

Across Asia initiatives are underway in at least 10 countries at different scales from site level to national system level. Three countries in Asia – Bhutan, India, and South Korea – are known to currently have legal instruments that explicitly enable corridors.

Many connectivity programmes in Asia have been driven by the conservation needs of flagship species such as the giant panda and tiger. Non-governmental organization (NGO) initiatives such as WWF's Eco-region Programme are also driving a number of corridor programmes such as the Terai Arc Landscape in Nepal.

The Central Truong Son Biodiversity Conservation Initiative in Viet Nam and the South West Elephant Corridor in Cambodia are the only current national corridor initiatives identified in the Lower Mekong Countries. Having clustered its forest protected areas into 20 complexes Thailand is embarking on a programme to create links between these assemblages of protected areas by working across different land tenure and management regimes.

Korea has established clear goals for the creation of an Eco-Network on the Korean Peninsula. The Korean programme includes establishing eco-corridors between areas of superb scenic and/or ecological value that can facilitate the movement of wildlife and

create ecologically healthy spaces in a move towards the conservation and management of national level ecosystems instead of fragmented efforts at habitat protection. Major efforts for the systematic conservation of vital ecosystems like the Baekdu Daegan Mountain System, the Demilitarized Zone, and small islands and coastal areas are underway as part of national policies pursuing sustainability and balanced national development.

In Japan a growing number of initiatives to develop ecological networks have been taken in recent years at municipal, prefectural, regional and national levels. For example, in 1996, the government decided that, as part of the Third National Land-Use Plan, it would “make efforts to network ecosystems in order to conserve biological diversity”, and in the Fifth Comprehensive National Development Plan–Grand Design for the 21st Century that was adopted in March 1998, the commitment was made to develop a national-scale ecological network.

3.2.2 Africa

In Africa connectivity efforts have predominantly been directed toward transboundary protected areas, particularly in southern and eastern Africa. These initiatives have been developed with high level political patronage. They serve multiple objectives including facilitating the range needs of large game species, community development needs and promoting international peace and harmony (‘peace parks’). Political and socio-economic barriers coupled with Africa’s legacy of colonial protected area establishment and the perceived disenfranchising of local people have all made progress at a continental scale challenging. No country in Africa is reported to have legislation that specifically enables corridors or other connectivity mechanisms.

3.2.3 Australia

All major Australian conservation strategies such as the *National Strategy for the Conservation of Australia’s Biological Diversity*, *National Biodiversity and Climate Change Action Plan (2003-2007)* and the *Directions Statement for the National Reserve System* promote the value and importance of biodiversity corridors. The latter notes that “...central to the conservation of Australia’s biological diversity is the establishment of a comprehensive, representative and adequate system of ecologically viable protected areas integrated with the sympathetic management of all other areas, including agricultural and other resource production areas”. Partnership approaches are reinforced through strategies which seek to extend the protected area system on private lands and involve non government groups, especially indigenous Australians, in planning and joint management. Australia’s connectivity initiatives are legally enabled through both national and state laws.

Australia has more recently developed a series of continental scale initiatives such as the ‘Gondwana Link’ and the ‘Alps to Atherton’ (A2A) initiative. A2A is a 2,800km corridor on the east coast of Australia which employs a range of regulatory, incentive and awareness mechanisms across public and private land.

3.2.4 Europe

Central and Eastern Europe pioneered ecological network concepts beginning in the early 1980s. Although more than 50 countries across Europe are involved in some type of connectivity initiative, only eight have legislation that specifically enables connectivity conservation. Lithuania’s 1993 Law on Protected Areas, amended in 1995, is the earliest such law identified by this study.

In this region ecological networks are being developed in three main ways: through the collaborative framework of the Pan-European Biological and Landscape Diversity

Strategy; through national or, in the Russian Federation, regional government programmes; and through various NGO projects. Of all of the countries in Central and Eastern Europe, the Russian Federation has the largest number of national corridor initiatives.

Europe also has some of the largest connectivity initiatives in terms of the number of participating countries. In 1995, 52 Eurasian countries endorsed the Pan-European Biological and Landscape Diversity Strategy. The agreement operates to a large extent as a coordinating framework within which national actions are being taken to conserve biological and landscape diversity. Many Eurasian countries were already developing national ecological network programmes when the Strategy was finalized, and many others have initiated comparable programmes since 1995 in a climate of increasing international coordination and strategic intent.

To date, the realization of ecological networks in Western Europe has flourished where governments have embraced the model and have used legislative and other policy instruments to secure action on the ground. Several countries have initiated nationwide ecological network programmes. In Denmark, through county-level plans and recently through an initiative for a national Nature Network by the Danish Society for Nature Conservation; in Switzerland, through the National Ecological Network; in Germany, through state-level ecological networks under the Federal Nature Conservation Act 2002; and in Italy, via the National Ecological Network.

The government of the Netherlands decided in 1990, following a multi-year research programme, to develop a National Ecological Network that could provide the long-term basis for ecological sustainability throughout the country. A long term perspective is taken with full implementation scheduled for 2018. The realization of the ecological network requires cooperation between a wide range of stakeholders: national, provincial and local governments, protected area managers, water authorities, farmers, foresters, other land owners and business. Three forms of land management are being applied in order to create the ecological network: protected areas of national or international importance, privately owned areas managed for nature conservation purposes (often agricultural land) and nature development areas. In addition to government regulations and local development plans, financial instruments such as subsidies and payments through voluntary agreements with land owners play an important role in securing implementation.

3.2.5 Latin America

In many ways Latin America has been leading international connectivity efforts with great progress in a number of countries for more than a decade. Nearly all countries in the region have engaged in corridor initiatives characterized by powerful political support, strong stakeholder engagement and livelihoods considerations. More than 100 corridors have been created in 16 countries; more than 20 of them involve three or more countries and a similar number are bilateral corridors (see the matrix in Annex 1). One of the earliest legal instruments enabling connectivity conservation is Bolivia's 1996 Regulation of the Forest Law. Although relatively few countries – Bolivia, Brazil and Venezuela – are reported to have national legislation that enables corridors Latin American countries, like European ones, have enabled connectivity conservation at sub-national levels as well. The provincial protected areas law of Salta, Argentina, enables corridors, and one corridor in Ecuador was created by ordinances issued by three cooperating municipalities.

The Mesoamerican Biological Corridor had its beginnings in 1994. Although covering only 0.5% of the world's land surface, Mesoamerica is home to about 7% of the planet's terrestrial biodiversity. This biological wealth is the result not only of Mesoamerica's particular environmental characteristics but also of its strategic position as a land bridge

connecting the biotas of the two American continents. About 30 ecoregions have been identified, an exceptionally large number for such a small landmass.

The plan for establishing the Mesoamerican Biological Corridor distinguishes four kinds of zones: core areas, buffer zones, corridors and multiple-use areas. Together these zones cover 27% of Mesoamerican territory. Within this area can be found 26 indigenous groups and all the major Mayan archaeological sites, such as Tikal, Chichén Itza and Copán. The basis of the Corridor's core areas are the region's 368 protected areas, 18 of which are larger than 100,000 hectares. Together they protect nearly 11 percent of Mesoamerica's land area. Building on this foundation, projects in the buffer zones, corridors and multiple-use areas encourage land users to test and adopt management practices that are both biodiversity-friendly and economically viable, using incentives such as payments for ecosystem services. Under this approach, communities and their governments develop strategies for land and water use that encompass entire ecosystems or bioregions, aiming to protect and restore them so they can simultaneously conserve biodiversity and sustain farming, forestry, fisheries, and other human uses.

3.2.6 North America

In North America, the most important initiatives are driven by NGOs that aim to achieve their goals through broad-based stakeholder processes. At the regional level, this includes collaboration with government authorities where possible in order to secure the necessary support through conservation policy and public land management. The corridor initiatives centre on biodiversity conservation with many based around wilderness concepts.

The best-known North American continental scale initiative is the Yellowstone to Yukon Conservation Initiative (Y2Y), extending along 3,200 km of the northern Rocky Mountains from Wyoming to the Arctic Circle. It was initiated in 1993 and is implemented by non-governmental organisations including the Canadian Parks and Wilderness Society. It includes areas protected under the national legislation of Canada and the United States, as well as private lands.

The Southern Rockies Wildlands Network is one of a series of six contiguous ecological networks that the Wildlands Project is developing along the Rocky Mountains in the United States. The Southern Rockies Wildlands Network encompasses federal, state and private land and is built up primarily from core wild areas, compatible-use areas and linkages. Establishing the network will require a mix of actions including government policy, private partnerships, public support and cooperation with Native American tribes.

3.3 Lessons Learned from International Experience

Evidence demonstrates that protected areas alone are not enough to conserve the diversity of natural systems and the processes that sustain them. Often set up to protect small isolated remnant habitats or natural environments, protected areas cannot by themselves ensure the maintenance of ecological integrity. Governments and civil society have come to this realization and corridor initiatives are emerging around the world at an increasingly accelerated pace.

Connectivity conservation involves a wide range of different land uses. The diversity of land uses means that successful conservation corridor initiatives require case-by-case responses, often at the local level, to achieve a balance that favours both biodiversity conservation and sustainable land and resource use.

International experience indicates that successful biodiversity conservation corridor initiatives require:

- a national vision and strategy coupled with high-level political commitment;
- a regulatory regime that at a minimum implicitly enables connectivity and preferably does so explicitly;
- a basis in comprehensive ecological assessments and sound scientific knowledge to maintain and enhance ecological coherence; and
- thinking beyond national level and working across international boundaries to bring additional conservation benefits through cooperation.

Key factors for success are described in sub-sections 3.3.1-3.3.9, below. Regulatory regimes are discussed in detail in section 4.

3.3.1 Corridors are effective in conserving biodiversity

It is obvious that species that require access to very large areas or need to migrate across a landscape require landscape connectivity to do so. For most species, however, extensive linked and buffered systems of core areas are not essential to their short-term survival, but are crucial for their long-term viability. Options that corridors can provide for species conservation include the survival of a full complement of species and communities within an ecosystem, the ability to recolonize “empty” habitat patches, the opportunity to move away from an existing area that comes under threat, and the occurrence of periodic natural disturbances that may require some form of linkage, such as flooding. Corridor design should therefore be flexible and cognizant of the varying needs of different species. A mosaic of approaches and different mechanisms is appropriate.

3.3.2 Connectivity conservation requires long-term commitment and planning

To plan, establish, and implement a corridor initiative requires a long-term perspective, recognizing that establishing sustainable and workable corridors takes time and patience. The Mesoamerican Biodiversity Corridor, for example, is perceived by its implementing partners as being a 30-year initiative. The Truong Son Biodiversity Conservation Initiative (also referred to as Mosaic) in Viet Nam is currently being planned as a 20-year initiative, and the ADB Biodiversity Conservation Corridor Initiative, which now includes the area of the Truong Son Biodiversity Initiative, is a 10-year initiative. Given the long period of time and the multiple stakeholders involved in planning and implementation, successful initiatives have prioritized projects and activities so as to first build support in the early stages, and then to later address longer-term conservation, social and economic needs.

3.3.3 Conservation corridors can be cost-effective

Corridors can be a relatively cost-effective alternative to enlarging traditional protected area systems as a means of achieving conservation objectives. This is true particularly if conservation corridors are established before habitats become extremely fragmented because it is more cost-effective to protect existing habitats than to restore degraded landscapes. In most countries that have created them, conservation corridors were demonstrably the only feasible and practicable option to achieve international, national, regional or local conservation objectives. In other cases, alternative courses of action, such as enlarging a protected area, would have involved serious problems that were avoided by creating corridors.

3.3.4 Conservation corridors need to be integrated into land use planning

Biodiversity corridors should be included as a component of land use plans for urban as well as rural areas and for relatively small areas as well as for entire regions. One of the most effective ways to do this is through the use of zones. While there is some variation in the number of zones used in different countries, the principal ones include:

- *core* areas which are protected areas whose purpose is to maintain biodiversity and generate environmental services for people living in and around these areas and beyond;
- *buffer zones* which are geographic areas usually surrounding and outside of protected areas. Some countries include buffer zones inside a protected area. The purpose of a buffer zone is to create an area which serves as a transition area within which land uses are managed to reduce impact on the core area;
- *corridor zones* which to provide the land or water pathways that link the core areas with one another. The area in a corridor may be natural, restored or, as is more common, already in human use especially for agriculture;
- *sustainable use zones (also referred to as multiple use zones)* which are areas that are designated for human settlement and use. These zones can be established outside of corridors as well as within both *buffer* and *corridor* zones. The concept is that sustainable use zones can form a mosaic through a landscape that can support biodiversity maintenance.

The size and placement of zones will largely depend on existing human settlement and land use. If human population is low and natural area or wildland remains, relatively large core zones and corridors can be established. However, in densely settled areas, the size of core zones and corridors will be limited.

3.3.5 Connectivity conservation requires new institutional arrangements and intersectoral cooperation

Biodiversity corridors not only transect land and water resources, they also transect institutions and demand a cross-sectoral approach that requires the cooperation of all government agencies whose interests are affected by corridors. This can include not only agencies concerned with natural resource management, but also those concerned with land allocation, agriculture and agricultural extension, transport, mining, tourism, energy, finance, and planning, among others. Natural resource agencies and institutions have to be cross-sectoral in their approach to creating and managing corridors and have the authority to coordinate and make decisions.

The precise role of institutions varies depending on national circumstances, but a number of institutional characteristics are common to the needs of many documented connectivity programmes. Prominent among these are the need for clear laws that are applied equally to all stakeholders, comprehensive zoning arrangements, effective enforcement procedures, financial security for corporate stakeholders and clearly-defined public and private land and resource use rights.

In addition to these features, the long-term process that characterizes the development and implementation of connectivity programmes requires that a particular vision of conservation and economic development be shared by the public and private sectors and by successive governments.

3.3.6 Multi-level and multi-stakeholder support is essential

Successful conservation corridor initiatives require agreement among: all levels of government from national to local; implementation agencies which may include government line agencies, NGOs, and community based organizations; and people directly impacted by a corridor, whether they live near the corridor or at a distance from it. It is difficult to reconcile the interests of different stakeholders. The time needed to reach agreement is one of the reasons that biodiversity corridors require a long-term commitment for implementation. While initial agreements may be signed by senior government officials, or in transboundary or regional initiatives by heads of state,

successful on-the-ground implementation of a biodiversity corridor requires the support of all stakeholders.

In order to reach and maintain the level of agreement needed for implementation, a biodiversity corridor initiative needs to undergo a process to: (1) identify common areas of interest and current and potential conflicts; (2) establish a process of communication and negotiation that allows differences to be negotiated and a shared understanding and vision of the purpose of the biodiversity corridor; and (3) address the needs of stakeholders, especially communities near or within the corridors and provide incentives for them to support the corridor. An important element of the process is to build trust among the various groups by inviting wide participation in planning and policy discussions at regional, national, and local levels.

A particularly difficult issue that confronts all conservation corridor initiatives is how to ensure that private sector stakeholders, particularly in the energy, mining and logging sectors, become fully involved in the programmes and committed to achieving their goals. A conspicuous lesson from international experience is that the initiation and management of connectivity initiatives is not the sole prerogative of government at the central level. In many countries, conservation corridors are initiated and driven by sub-national government authorities, research institutions, and NGOs.

3.3.7 Conservation corridors are a component of sustainable community development

Experience has shown that connectivity conservation provides tangible benefits in the short term even though corridors are long-term initiatives. This is possible when community needs, including livelihood security and poverty alleviation, are taken into account at the planning stage and genuine participatory processes are used from the outset.

While the principal goal of corridor planning is to maintain or restore connectivity across a landscape, biodiversity corridor initiatives, as they have evolved over the last decade, integrate conservation interests with those of social, economic and rural development. The areas designated for biodiversity corridors often contain not only valued flora and fauna species but also human populations that are dependent on the natural resources within a biodiversity corridor and that may be among a country's poorest. Reflecting the national and global commitment to poverty reduction and the Millennium Development Goals and the recognition that the rural poor should not be further impoverished, biodiversity corridor initiatives provide new opportunities for rural people to assume management responsibilities and to share in the economic benefits derived from natural resources.

In most cases corridors do not require the exclusion of human use of the landscape and in practice a wide variety of uses are often acceptable. These include extensive farming practices (Estonia), sustainable harvesting of non-timber forest products and the cultivation of organic cocoa (Mesoamerica), ecotourism and sustainable forestry in indigenous territories (Vilcabamba-Amboró, Peru and Bolivia), the establishment of tree nurseries (Terai Arc Landscape, Nepal) and planning for appropriate forms of agriculture and promoting recreational opportunities (the Netherlands).

3.3.8 Public awareness and access to information are essential

The success of a biodiversity corridor depends on stakeholders being informed about how the corridor will affect them, how they can participate in its design, and how they can participate in monitoring its success. As with other conservation initiatives, the support of stakeholders who will be directly impacted by the corridor depends on awareness of the importance of the area for biodiversity conservation, including its environmental, cultural,

and economic services, and information on how the corridor can protect services and resources that affect social and economic well-being, especially poverty reduction.

A problem for many connectivity initiatives is that they are being undertaken at a scale that hinders close cooperation with local communities and that as a result the communities may perceive the corridor as irrelevant to their livelihoods. Only by demonstrating that a corridor is part of an integrated approach to biodiversity conservation and economic development at the regional level and that it offers benefits at the local level can these challenges be met.

3.3.9 Connectivity conservation requires capacity building

Conservation corridors are a relatively new concept. Particularly in the Greater Mekong Subregion, there is little on-the-ground experience with them. Each category of stakeholder will require new skills both for planning and implementation of connectivity initiatives. Conservationist professionals must learn how to relate ecosystem and species conservation to poverty reduction and how to management participatory processes to achieve multi-stakeholder consensus on and support for conservation measures. Local officials, individuals and communities must learn the basis of biodiversity conservation planning, management and monitoring. Policy and law makers must have an in-depth understanding of the purpose of connectivity conservation in order to be able to develop policies and legal frameworks that support integrated land use planning and management and provide incentives, including sustainable financing, for their long-term implementation.

4. Legal Instruments Enabling Connectivity Conservation

This study identified 17 countries that have adopted legal instruments at national or sub-national level to create or enable corridors and other types of connectivity conservation measures. The earliest of these was Lithuania's Law on Protected Areas, adopted in 1993 and amended in 1995. A total of 14 of countries identified have national laws, or equivalent legal instruments, creating or enabling corridors:

Bhutan	Royal Government of Bhutan Decree, November 1999, enabling the Bhutan Biological Conservation Complex
Brazil	Law No 9.985, 18 July 2000, establishing the National System of Nature Conservation Units
Bulgaria	Biological Diversity Act, as amended in 2005
Canada	Muska Kechika Management Area Act 1998
Denmark	Consolidated Planning Act No. 883, as amended at 18 August 2004
Germany	Federal Nature Conservation Act 2002
Hungary	Act LIII of 1996 on Nature Conservation and Act No. XXVL of 2003 on the National Spatial Plan
India	Indian Wildlife Protection Act 1972, as amended in 2002
South Korea	Act on the Protection of Baedku Daegan Mountain System 2003
Lithuania	Law on Protected Areas 1993, as amended in 1995
Poland	Act on Nature Protection, 16 April 2004
Slovakia	Law No. 543/2002 on Nature and Landscape Protection
Ukraine	Law on the Ecological Network 2004
Venezuela	Biological Diversity Law, 24 May 2000

National regulations enabling corridors are in effect in one Latin American country:

- Bolivia – Supreme Decree No. 24453, approving the General Regulation of the Forestry Law, No. 1700 of 12 July 1996.

Sub-national legal instruments create or enable corridors in two Latin American countries;

- Argentina, Salta Province – Law 7107 Salta Provincial Protected Areas System, 8 November 2000; and
- Ecuador, Baños, Mera and Palora municipalities – ordinances issued by each municipality.

Only one country identified – Ukraine – has a specific law on connectivity conservation. Other countries have used a variety of types of laws to enable and create corridors (see Table 1).

Half of the countries identified have used nature conservation laws and protected area laws to enable connectivity. One country – India – enables corridors through its Wildlife Protection Act, which also governs protected areas. India and Slovakia, through its Law on Nature and Landscape Protection, provide that corridors are included in categories of protected areas. Bolivia's Regulation of the Forestry Law provides multiple complementary measures from which local authorities can choose in creating and managing corridors.

Other countries have used biodiversity laws and land use/spatial planning laws for the same purpose. In Hungary, the provisions of the 1996 Nature Conservation Act and the 2003 National Spatial Plan Act are complementary, ensuring that corridors linking protected areas are included in national land use planning. In Denmark, the Consolidated Planning Act enables corridors by requiring that they are included in municipal land use plans. Ukrainian law also specifically links the Ecological Network to land use planning and requires periodic review.

Institutional arrangements for the creation and management of corridors vary from country to country. In Hungary and Venezuela, for example, national-level authorities are primarily responsible. In Argentina and India, this responsibility is delegated to provincial and state-level authorities, while in Denmark and the Netherlands, it is given to provinces and municipalities. Slovakia has created a supra-regional authority to coordinate management of connectivity conservation at the sub-national level.

Table 1. Legal Instruments Used to Create and Enable Connectivity Conservation

	Connectivity law	Legal instrument creating or enabling a specific corridor	Protected areas law	Spatial planning law	Biodiversity law	Nature conservation/ protection law	Wildlife law	Forestry regulations
Argentina			✓ Sub-national law					
Bhutan		✓						
Bolivia								✓
Brazil			✓					
Bulgaria					✓			
Canada		✓						
Denmark				✓				
Ecuador		✓ Municipal ordinances						
Germany						✓		
Hungary				✓		✓		
India							✓	
South Korea		✓						
Lithuania			✓					
Netherlands				✓				
Poland						✓		
Slovakia						✓		
Ukraine	✓							
Venezuela					✓			

5. Connectivity Initiatives Facilitated but Not Directly Enabled by Law

In the absence of legal instruments that specifically enable connectivity conservation, several countries have creatively used existing laws to facilitate connectivity conservation and the creation and management of corridors. These initiatives have been initiated by sub-national government authorities, NGOs or independent research institutes, and at the community and individual level through voluntary agreements and individual and community initiatives. In most cases, national law enables protected areas, wildlife conservation, land use planning or some combination of these measures, but not connectivity.

In some countries, planning, local government, and other types of legal instruments offer opportunities for supporting connectivity conservation through the use of incentives such as tax concessions, grants, technical support and materials, development concessions, management agreements, revolving funds, environmental levies and developer contributions. For example in New South Wales, Australia, a suite of legislation indirectly supports a common objective of connectivity conservation. In New South Wales this includes legislation such as the Wilderness Act (1987); Environmental Planning & Assessment Act (1979); Local Government Act (1994) and the Catchment Authorities Act (2003) among others.

Some countries – Australia, for example – allow communities to create community conservation areas that are not part of the national protected areas system, but which can be linked to formally protected areas by corridors. And some countries – Peru, for example – allow private property owners to enter into voluntary agreements to help conserve natural habitat and species on their lands or allow individuals to purchase private property to conserve habitats. Private protected areas, which can also be linked to public protected areas by corridors, may be enabled by national protected areas laws or simply by national and sub-national property laws that enable the sale and lease of land by individuals.

The Netherlands creates corridors through the interaction of policy and law. National policy enables an ecological network, but national law does not although there are calls to amend the 1998 Nature Conservation Act to include the network. The Spatial Planning Act does not enable corridors either, but it does mandate that provincial and local zoning plans are legally binding. When provincial and local authorities implement national policy on the national ecological network and include corridors in their zoning plans, the result is that corridors become part of a legally binding framework.

In Nepal, protected area legislation that enabled the establishment of buffer areas and community conserved areas assisted connectivity conservation based on a strategic plan, and a partnership between government departments and NGOs in the Terai Arc Landscape.

Wildlife legislation, including endangered species legislation, which protects fauna and flora on private as well as public land, is an important factor in the success of the Yellowstone to Yukon transboundary conservation corridor in the United States and Canada.

Other examples include:

International

- Connectivity achieved through the leadership by two governments (Maloti-Drakensbergs Transfrontier Conservation and Development Programme);
- Connectivity involving local communities and facilitated by NGOs and governments (the ICIMOD-facilitated Sacred Himalayan Landscape of Nepal, India and Bhutan; the European Green Belt – 22 countries along the former “Iron Curtain”);
- Connectivity achieved initially by “on-ground” consultation among protected area management staff which ultimately led to the signing of a Memorandum of Understanding by the ministers of three countries (the Greater Virunga Landscape);
- Connectivity initiated by independent research institutes (Sava River Ecological Network (research institutes in Slovenia, Croatia, Bosnia, Herzegovina and Serbia and Montenegro, plus IUCN and the International Agricultural Centre, Netherlands);
- Connectivity initiated by an international NGO (TRIDOM Ecoregion project, Cameroon, Gabon, Congo, WWF);

National

- Connectivity promoted by national, sub-national and local government authorities on the basis of existing management planning (Ecological Network of Latvia; Volga-Ural Econet, Russian Federation);
- Connectivity promoted by collaboration among national government authorities and national research institutions (National Ecological Network of Moldova);
- Connectivity initiated through cooperation between national government authorities and an international organization (ECONET Poland, IUCN);
- Connectivity initiated by sub-national government authorities and supported by a regional plan (Ecological Network of the Orenburg Oblast, Econet of the Russian Forest-Steppe Region, Russian Federation);
- Connectivity led by a consortia of NGOs and local community groups (Australian Gondwana Link);
- Connectivity initiated by a national NGO (Arakawa River Ecological Network, Ecosystem Conservation Society, Japan).

6. Conclusions

Despite a great variation in the terminology being used around the world to describe connectivity conservation, several common elements have emerged from international experience over the past 15 years. The scale of connectivity initiatives varies from local to international. Most have a common goal of achieving biodiversity conservation while maintaining sustainable use of resources. All of them require a mix of regulatory, incentive and awareness-raising measures to be successful.

Connectivity conservation has been initiated by governments, research institutions and NGOs. These initiatives are often being driven from the bottom up, whether by sub-national and local government authorities or local NGOs. Successful initiatives depend on finding workable ways of dealing with ‘boundaries’ at all levels: political, jurisdictional, socio-economic, cultural and legal.

Several of these initiatives have been undertaken in the absence of any enabling framework of policy or legislation. More often, the proponents have relied on the creative use of a combination of policy and legal instruments to enable the initiatives. At least one country – Slovakia – has found that most conflicts in implementing its National Ecological Network result from contradictions between existing laws.

Since 2000, governments have increasingly begun to enact laws that specifically enable corridors, in a sense “catching up” with connectivity conservation practice to create the regulatory frameworks required to fully support it. Except for Ukraine, which has a law dedicated to its ecological network, most countries enable corridors and provide strategic direction for their management by one or more different types of laws, leaving detailed provisions to be issued as regulations.

Lessons for Viet Nam that emerge from international experience with conservation corridors and the laws that enable them indicate that a regulatory framework should:

- Be based on policy that outlines a clear national vision and strategy for connectivity conservation;
- Be based on a law that enables corridors and provides for implementing regulations;
- Harmonize sectoral legal instruments that govern aspects of connectivity conservation to eliminate conflicts that would create obstacles for creating and managing corridors;
- Mandate that planning and management of conservation corridors be linked to the national protected areas system and be included in local, sub-national and national land use planning and plans;
- Empower government institutions, community groups and individuals, research institutions and NGOs to initiate and participate in connectivity conservation initiatives;
- Provide for a variety of possible coordination mechanisms to manage connectivity conservation, ranging from local level to supra-regional and from national to international;
- Provide multiple complementary measures among which local authorities can choose in creating and managing corridors;
- Enable incentives for all stakeholders – the public and private sectors, communities and individuals;
- Mandate access to and sharing of information on connectivity conservation in general and on the issues involved with individual corridors in particular;
- Require monitoring and evaluation of the effectiveness of corridors and their contribution to local livelihoods and to biodiversity conservation objectives at the national, sub-national and local levels.

7. References

Some important references which provide background and case study material for protected area management, transboundary protected area management and connectivity conservation are listed here. The report prepared by Dr Graham Bennett and Dr Jo Mulongoy in 2006 (*CBD Technical Series No 23: Review of experience with ecological*

networks, corridors and buffer zones) is particularly important, and should be referred to in addition to this review. Equally the brief report on *Mechanisms that enable the Planning, Establishment and Management of Biodiversity Connectivity Conservation* prepared by Dr Graham Bennett and Graeme Worboys in 2007 has been very helpful in compiling this review.

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Annex 1