The Legal Aspects of Connectivity Conservation

A Concept Paper

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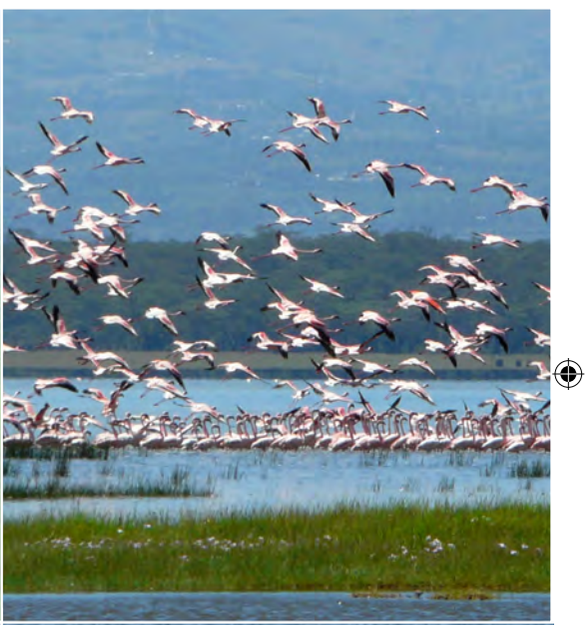
Project Director: Françoise Burhenne



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Foreword

The *Legal Aspects of Connectivity Conservation: A Concept Paper* is the result of dedicated work and collaborations that began in 2011 and continued through to completion of the project at the end of 2012. The publication builds upon and complements the *IUCN Guidelines on Protected Areas Legislation* (Lausche 2011), which set out key elements for modern protected areas (PA) legislation. As a major project in its own right, the *Guidelines* were not able to analyse in depth the critical law and policy aspects of conservation initiatives outside protected areas that are needed to sustain and increase their resilience in the face of ongoing threats from development and increasing global change, including climate change.

Since the 1980s, scientists and PA managers have warned that protected areas, as part of increasingly fragmented and degraded natural ecosystems, will become isolated 'ecological islands', less able to stem the accelerating loss of terrestrial and marine biodiversity and less able to maintain ecosystem functions, such as species migration and hydrological flows, that operate at the landscape/seascape level. The conclusion: protected areas need to be integrated into and be better 'connected' to their broader landscapes and seascapes if they are to survive and maintain their biodiversity values and functions over time. To do this, conservation of the physical links between protected areas and areas outside their boundaries must be a central focus. The scope of that focus must embrace the conservation of landscape/seascape connectivity, connectivity of ecological processes, species habitat and genetic evolutionary process connectivity. The supportive tools must necessarily include law.

This concept paper was produced through close collaboration of the IUCN Environmental Law Centre (ELC), the World Commission on Environmental Law (WCEL), the Global Protected Areas Programme (GPAP), and the World Commission on Protected Areas. It aims to advance conceptual thinking and legal understanding about important law and policy tools and options for supporting the connectivity of protected area systems. There is now an urgent need to develop legally-grounded tools and techniques to enhance the ability of protected areas to adapt to climate change, maintain essential ecosystem processes, and meet human needs, including water production, soil conservation, and marine nutrient recycling. In addition, well-managed and expanded terrestrial and marine protected area systems and networks are playing an increasingly important role in sequestering additional atmospheric carbon for climate change mitigation.

The legal research and analyses reflected in this paper span international, regional, national and local levels. A range of legal instruments existing in most national legal systems, from conservation and sustainable use laws to land use planning, development control, voluntary conservation and economic instruments are explored. The paper is intended to offer concrete ideas of existing and potential legal tools and approaches that countries can use immediately to initiate priority connectivity conservation actions and to strengthen them progressively. It also is intended to provide a conceptual baseline for future research and case studies to continue to define and develop connectivity conservation law for supporting protected areas and for providing opportunities to address climate change as part of biodiversity conservation agendas.

This project has two additional components, which are intended also to advance the objectives of the paper. They are first five case studies of connectivity conservation initiatives and their associated national legal frameworks (Australia, Brazil, South Africa, The Netherlands, and legal tools for connectivity conservation in the European Union) and second the development of modern PA legal frameworks with consideration of climate change in two Small Island Developing States, Timor-Leste and the Dominican Republic, which will be reported separately. It is our hope that this concept paper

will advance initiatives and stimulate concrete action to strengthen legal frameworks for connectivity conservation and the critical role connectivity must plan in conservation of protected areas and biodiversity in all countries of the world.

We would like to congratulate and thank the authors of this publication, the authors of the case studies, the ELC staff and the members of the Project Steering Committee for their commitment and hard work.

Finally we gratefully acknowledge the financial support of the German Federal Ministry for Economic Cooperation and Development (Bundesministerium für wirtschaftliche Zusammenarbeit und Entwicklung).

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Preface and acknowledgements

We wish to acknowledge and thank all the participants, collaborators, and supporters who were involved throughout the process of implementing this project and made it a success. Our thanks go first to the IUCN World Commission on Environmental Law (WCEL), the IUCN Global Protected Areas Programme (GPAP), and the IUCN World Commission on Protected Areas (WCPA) for their continued support and collaboration. While the IUCN Environmental Law Centre (ELC) led, managed and coordinated the project, these continued collaborations made it possible to identify and mobilize the steering group, advisors, and reviewers with special expertise in connectivity conservation and authors for the Concept Paper and the five case studies.

Second, thanks are extended to the several individuals listed below who played key roles in production of this paper, dedicating their time, expertise, commitment, and ideas throughout the process of formal meetings, informal consultations, electronic and hard-copy reviews, and many exchanges by email and skype. These individuals served in their personal capacity as steering and advisory group members and authors, alongside ELC staff who also participated throughout.

Four meetings in Bonn provided the critical opportunity for all participants to interact, plan, comment on drafts, learn from each other, and generate new ideas. The first meeting was convened in July 2011 for the purpose of agreeing on the content of the paper, a work plan, time schedule, and specific tasks for the lead authors. Thereafter, the detailed proposed outline presented at the meeting was finalized, and the lead authors began work on their assigned sections. Those components were circulated and reviewed at a second meeting in Bonn in February 2012. Following that meeting, the authors undertook additional research, and produced revised drafts of their sections which were consolidated into a near-final version for the third review meeting in Bonn in June 2012. Taking into account comments and advice from that meeting, the concept paper was made ready for the IUCN World Conservation Congress (WCC) 2012 in Jeju, South Korea, in early September. It was launched with CD copies at the WCC workshop on 'Connectivity Conservation, Law and Beyond: for an environmentally and socially resilient planet' (co-sponsored by WCPA, WCEL, TILCEPA, and CEESP), which included presentations by Barbara Lausche, Alexandra Peterson, and Ben Boer, and a summing up by Ian Walker. In November 2012, a final organisational meeting of the Steering Group and authors took last decisions on the project before its closure December 31, 2012. The November meeting also presented a workshop to a small group of invited experts, including from German governmental agencies, and international and non-governmental technical and policy institutions and groups working on connectivity issues.

Special thanks are due for the contributions made by the following individuals who served as steering and advisory group members to guide the entire project and review successive drafts of the project:

- Antonio Benjamin, Justice, High Court of Brazil [STJ]; Chair, IUCN World Commission on Environmental Law (WCEL)
- Ben Boer, Deputy-Chair WCEL; WCPA member; Co-Chair of the Joint WCEL/WCPA Specialist Group on Protected Areas Law and Policy; Distinguished Professor, Research Institute of Environmental Law, Wuhan University, China; Professor Emeritus, Australian Centre for Climate Change and Environmental Law, Faculty of Law, University of Sydney, Australia
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- Alejandro Iza, Head, IUCN Environmental Law Programme (ELP); Director, IUCN-ELC
- Patti Moore, Independent Consultant (Environmental Law and Governance); WCEL and CEESP Member

- Alexander Ross Paterson, Member Joint WCEL/WCPA Specialist Group on Protected Areas Law and Policy; Professor of Law, Director/Institute of Marine and Environmental Law, University of Cape Town, South Africa; WCEL member
- Trevor Sandwith, Director, Global Protected Areas Programme (GPAP), IUCN, Gland
- Graeme Worboys, Protected Areas Management Specialist, Australia; WCPA Vice-Chair on Mountains and Connectivity Conservation; Member, Joint WCEL/WCPA Specialist Group on Potected Areas Law and Policy.

Special recognition also is due to the authors of the concept paper and the authors of the case studies. The project is deeply indebted to these individuals for the time, talent, and dedication they gave to making the paper a significant contribution in the field of law. All authors are experts in their assigned areas (a short bio of each is provided below, following this Preface). While the lead authors had responsibility for specific components of the Concept Paper, they also reviewed and provided comments on all sections and the final draft.

The lead authors and other contributors are identified below in relation to the tasks for which they were primarily responsible in the concept paper (published as VOLUME 1).

Barbara Lausche took the overall lead, preparing the detailed outline, coordinating and harmonizing author components and the final key messages and conclusions, and preparing introductions, transition text, and substantive sections on connectivity conservation science and management, conservation and sustainable use laws, and special legal issues for marine connectivity.

David Farrier took the lead with the governance section. He also took the lead, working in collaboration with Jonathan Verschuuren, in the land use planning, development control and voluntary conservation sections. Together with Jonathan Verschuuren and Charles-Hubert Born, he prepared the section on economic instruments. Throughout the paper, he contributed perspectives from the point of view of common law systems of countries such as Australia and the UK.

Jonathan Verschuuren prepared the special section on legal instruments for connectivity conservation in the European Union (EU). He also contributed a European and civil law perspective to the land use planning, development control and voluntary conservation sections, and provided civil law examples, especially from Europe. Together with David Farrier and Charles-Hubert Born, he prepared the section on economic instruments. He also reviewed and provided comments on all sections of successive drafts.

Antonio G. M. La Viña took the lead with the benefits section and directed his special expertise and perspectives to the benefits of connectivity conservation for climate change adaptation and mitigation, with particular attention to the potential for REDD+ to support connectivity conservation initiatives enhancing protected areas and biodiversity conservation for these purposes. In this work, he collaborated with Lawrence Aug.

Arie Trouwborst prepared the sections on international law at both the global and regional levels, identifying areas where instruments dealing with biodiversity, climate change, or natural resources require or support connectivity conservation as part of the obligations and commitments of Parties to those instruments.

Charles-Hubert Born's contribution concentrated on the section about economic instruments, which was a joint effort with Jonathan Verschuuren and David Farrier. In addition, he provided special insights and examples of the use of economic instruments for connectivity conservation in the countries of the European Union.

Lawrence Aug collaborated with Antonio La Viña on the benefits section, particularly with the REDD+ and co-benefits discussions.

Authors for the five case studies (published as VOLUME 2) are as follows:

- Australia, David Farrier and Melissa Harvey
- Brazil, Solange Teles de Silva and Márcia Diegues Leuzinger
- EU, Jonathan Verschuuren and Mariya Gromilova
- The Netherlands, Arie Trouwborst
- South Africa, Alexander Ross Paterson

ELC staff lawyers also participated actively in the project. Special thanks go to Françoise Burhenne, in charge of developing and directing the project overall and the production of the Concept Paper and related Case Studies, and to Sarah Lucas who helped manage the project process in addition to being responsible for reviewing and advising on the case studies.

Special thanks also is due to all the staff of ELC who worked behind the scenes to provide essential support throughout the project. In addition, special thanks go to two individuals: Anni Lukács, Senior Documentation and Information Officer, for producing the templates and making the document ready for professional publication and Ann DeVoy, Project Administrator, for the many administrative and logistical tasks, including arrangements for meetings in Bonn, for the project as a whole. A number of interns should also be recognized for their assistance, especially ELC intern Melania Di Vara, who started the research which underpinned the analyses that followed. Also, Luke Maier, an intern working with Barbara Lausche in the United States, provided helpful research and graphic assistance with the connectivity illustrations.

Finally, it is important to acknowledge that what has been achieved could not have been possible without the two-year grant provided by BMZ, the German Federal Ministry for Economic Cooperation and Development. All those mentioned in this Preface thus express their gratitude to BMZ for the project support received.

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Concept Paper (Volume 1)

Barbara Lausche is an international environmental lawyer who has spent much of her career providing legal drafting and technical assistance in conservation law and policy. She is the author of the *IUCN Guidelines for Protected Areas Legislation* (2011), and became involved with the IUCN Environmental Law Programme in the late 1970s, writing the first version of those *Guidelines* (1980) after serving in Africa (Peace Corps volunteer) as legal drafter of national wildlife and protected areas legislation. Her career has included managing the World Wildlife Fund-US Legal Technical Assistance Program in the 1980s, and during the 1990s serving as the World Bank's first full-time environmental lawyer and then Programme Coordinator at the Global Environment Facility Secretariat. In recent years she has focussed on the Caribbean and wider Gulf of Mexico, and is presently Director of the Marine Policy Institute at the Mote Marine Laboratory, a national marine science research centre located in Florida, USA. She is a member of WCEL and WCPA.

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Lawrence Aug is a Fellow at the Ateñeo School of Government of the Philippines, with several years of experience in the public and private sectors, primarily in climate change policy and sustainability innovations, among them integrating biodiversity into business decision making and operations. He has been a technical advisor on climate change, land-use and forestry issues, including REDD+, to the Philippine Government and was a member of the Philippine delegation to the UNFCCC between 2009-2011. Mr. Aug graduated from the Australian National University with majors in natural resource management and human ecology, and was a recipient of the 2008 MR Jacobs Prize for Silviculture.

Case Studies (Volume 2)

David Farrier is Emeritus Professor of Law at the University of Wollongong, NSW, Australia. In 2002, he was made a lifetime Honorary Fellow of the Planning Institute of Australia for his work on the *Environmental Law Handbook: Planning and Land Use in New South Wales*, now in its 5th edition. He is an environmental/natural resources lawyer with expertise in legal instruments for private land management, and is particularly focused on fostering collaborations between lawyers and ecologists to develop appropriate policy responses in relation to nature conservation. In 2012, he was a member of a consultancy team which produced a report for the Commonwealth Department of Sustainability, Environment, Water, Population and Communities on *Local Government Approaches to Planning and Managing Conservation Connectivity and Wildlife Corridors*. He is a member of WCEL.

Dr Melissa Harvey completed her PhD in Microbial Genetics at the University of New South Wales in 1996. After working in the biotechnology industry for many years she has recently completed a law degree at the University of Wollongong, in the course of which she developed her interest in environmental and planning law. Her legal training included a placement in the policy section of the New South Wales Environmental Defender's Office.

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Jonathan Verschuuren is Professor of International and EU Environmental Law at the Tilburg Sustainability Centre at Tilburg University, the Netherlands. His research focuses on climate change adaptation. He has published extensively on various aspects of adaptation, including on adaptation for biodiversity conservation. Verschuuren is the editor of *Research Handbook of Climate Change Adaptation Law* (Edward Elgar Publ. 2013). He is a member of the (European Commission sponsored) Malta Forum of Legal Experts on Adaptation and a member of WCEL.

Mariya Gromilova is a PhD candidate in the field of climate-induced population displacement at Tilburg Law School, the Netherlands. As a participant in the current IUCN research project on connectivity conservation and law, she collected relevant data and summarized national connectivity-related legislation of the EU Member States. Among her most recent activities is a contribution on climate-induced migration to the *Research Handbook on Climate Change Adaptation Law* by Jonathan Verschuuren (Edward Elgar Publ., 2013).

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Alexander Ross Paterson is currently Professor of Law and Director of the Institute of Marine and Environmental Law, University of Cape Town, lecturing in environmental law at both undergraduate and postgraduate levels. Prior to joining the Institute in 2004, he practised as an environmental attorney and environmental consultant for several years, and is licensed to practice law as a Cape Town Attorney of the High Court of South Africa. He has also worked in the NGO sector monitoring the progression of environmental legislation through Parliament. His areas of interest and research include biodiversity, protected areas and incentive-based regulation. He is currently a member of WCEL and WCPA, and a member of the WCEL/WCPA Specialist Group on PA Law and Policy. He has BSocSci, LLB, LLM, PhD degrees.

Acronyms and abbreviations

ACCOBAMS	Agreement on the Conservation of Cetaceans of the Black Sea, Mediterranean Sea and contiguous Atlantic Sea
ACT	Australian Capital Territory
AEWA	African-Eurasian Waterbirds Agreement
ASCOBANS	Agreement on the Conservation of Small Cetaceans of the Baltic, North East Atlantic, Irish, and North Seas
AWG-LCA	Ad Hoc Working Group on Long-term Cooperative Action (UNFCCC)
BDMS	Baekdu Daegan Mountain System (South Korea)
CAP	Common Agricultural Policy (EU)
CASS	Conservation of Atlantic Salmon in Scotland
CBD	Convention on Biological Diversity
CIFOR	Center for International Forestry Research
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CMS	Convention on the Conservation of Migratory Species of Wild Animals
COP	Conference of the Parties
CWATUPE	Code wallon de l'aménagement du territoire, de l'urbanisme, du patrimoine et de l'énergie.
DSEWPaC	Department of Sustainability, Environment, Water, Population and Communities (Australia)
EAFRD	European Agricultural Fund for Rural Development
ECHR	European Convention on Human Rights
EEA	European Environment Agency
EEZ	Exclusive Economic Zone
EIA	Environmental Impact Assessment
ELC	Environmental Law Centre (IUCN)
ELP	Environmental Law Programme (IUCN)
ESA	Endangered Species Act (US)
ESC	Economic and Social Council (UN)
ETS	Emissions Trading Scheme

EU	European Union
FAO	Food and Agriculture Organization of the United Nations
FONAFIFO	National Fund for Forest Financing (Fondo Nacional de Financiamento Forestal) (Costa Rica)
FPIC	Free, Prior and Informed Consent
GIS	Geographic Information System
GRID	Global Resource Information Database (UNEP)
GtC	Gigatons of Carbon
HNV	High Natural Value
IAS	Invasive Alien Species
ICC	International Co-ordinating Council (MAB)
ICOM	Integrated Coastal and Ocean Management
IDDRI	Institut du dévelopment durable et des relations internationales (France)
IMO	International Maritime Organization
IPCC	Intergovernmental Panel on Climate Change
IPPC	Integrated Pollution Prevention and Control (EU)
IUCN	International Union for Conservation of Nature
KFS	Korean Forest Service (South Korea)
LSA	Land Suitability Assessment
MAB	Man and the Biosphere Programme (UNESCO)
MARPOL	International Convention for the Prevention of Pollution from Ships
MEA	Millennium Ecosystem Assessment
MEAM	Marine Ecosystems and Management
MoE	Ministry of Environment
MOP	Meeting of the Parties
MOU/ MoU	Memorandum of Understanding
MPA	Marine Protected Area
MRV	Measurement, Reporting and Verification
MSFD	Marine Strategy Framework Directive (EU)
MSP	Marine Spatial Planning
NGO	Non-governmental organization

NOAA	National Oceanic and Atmospheric Administration (US)
NRC	National Research Council (US)
NRMMC	Natural Resource Management Ministerial Council (Australia)
NSW	New South Wales (Australia)
NWC	Draft National Wildlife Corridor Plan (Australia)
NWC	National Wildlife Corridors
OECD	Organisation for Economic Co-operation and Development
OSPAR	Oslo/ Paris Convention for the Protection of the Marine Environment of the North-East Atlantic
PEEN	Pan-European Ecological Network
PES	Payment for Ecosystem Services
PSA	Pago por servicios ambientales (Costa Rica)
PSSA	Particularly Sensitive Sea Area
RBMP	River Basin Management Plan
REDD/ REDD+	Reducing Emissions from Deforestation and Forest Degradation
RIKS	Research Institute for Knowledge Systems
SA	South Australia
SAC	Special Area of Conservation
SBSTA	Subsidiary Body for Scientific and Technical Advice (UNFCCC)
SCBD	Secretariat of the Convention on Biological Diversity
SEA	Strategic Environmental Assessments
SKNL	Subsidieregeling Kwaliteitsimpuls Natuur en Landschap (the Netherlands)
SNL	Subsidie Natuur- en Landschapsbeheer (the Netherlands)
TDR	Tradeable Development Right
TEEB	The Economics of Ecosystems and Biodiversity
TNC	The Nature Conservancy
TRIDOM	Tri-National Dja-Odzala-Minkebe Project
UK	United Kingdom
UN	United Nations
UNCED	United Nations Conference on Environment and Development (Rio Earth Summit)

UNCLOS	United Nations Convention on the Law of the Sea
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change
UNU-INWEH	United Nations University Institute for Water, Environment & Health
U.S.	United States
USU	Utah State University
USA	United States of America
WCEL	World Commission on Environmental Law (IUCN)
WCMC	World Conservation Monitoring Centre (UNEP)
WCPA	World Commission on Protected Areas (IUCN)
WCS	Wildlife Conservation Society
WFD	Water Framework Directive of 2000 (EU)
WWF	World Wildlife Fund
Y2Y	Yellowstone to Yukon (US)

Overview of research findings

The overarching conclusion from the research and analyses undertaken for this project as presented in this paper is the need for countries to become increasingly alert to their connectivity conservation needs, undertake connectivity planning, and initiate actions using existing mechanisms and opportunities as much as possible to negotiate and protect critical connectivity areas before they are lost to development. To support this process, a related conclusion is that a wide array of different legal instruments and tools already exist in many legal systems to begin to promote and implement science-based connectivity actions in priority landscapes/seascapes and local sites. Countries should start with these tools, using the best scientific information available, before development pressures make conservation or restoration no longer economically or political feasible. As experience is gained working with communities and landholders, and managing for connectivity conservation, a foundation of knowledge and support can be built for amending or enacting new legislation, as needed, to strengthen and integrate connectivity conservation authority into legal frameworks. Opportunities to use existing law and policy instruments should not be delayed by those efforts. 1

It also is important to recognize that the law, by its nature and function, aims for clarity, certainty, and clearly defined processes and criteria for achieving specific goals and objectives. These features are essential for societies to have orderly interactions and effective future planning. In contrast, connectivity conservation is a tool for adapting to change due to dynamic factors related to current and new threats to protected areas, biodiversity and ecosystems, and to global change including climate change. 2

Bringing the law and connectivity together requires that the law incorporate some flexibility in order for management to be able to respond to changing connectivity conservation needs and that connectivity conservation actions be based on the best available scientific information (in both the natural and social sciences) so that management actions and commitments are well founded for the foreseeable future. Law has several mechanisms that can provide flexibility. These include requirements for periodic review and revision of management plans, regular monitoring based on ecological criteria, the development of performance measures to help assess and evaluate whether management plans are achieving their intended purposes, and decision-making mechanisms to monitor and incorporate new scientific information relevant for connectivity conservation management as it becomes available 3

This paper closes with several key messages that build upon and are supplemented by more specific messages in each of the technical sections. These messages are offered with the view that, together with the *IUCN Guidelines for Protected Areas Legislation*, they may serve as a baseline or platform for future research and case studies that may be undertaken to continue to define and develop connectivity conservation law. It is also hoped that these messages and the paper overall may provide insights and reinforcement to countries and organizations already moving forward with connectivity actions on the variety of legal options that may be available, how they may be used, and the resulting benefits that may be gained for biodiversity conservation, maintaining essential ecosystem functions and advancing climate change strategies. 4

Introduction

Context

Connectivity conservation and the management of connectivity conservation areas are emerging fields of scientific study and conservation management practice within the broader subject of nature conservation. In the most basic terms, connectivity conservation is a conservation measure in natural areas that are interconnected and in environments that are degraded or fragmented by human impacts and development where the aim is to maintain or restore the integrity of the affected natural ecosystems, linkages between critical habitats for wildlife, and ecological processes important for the goods and services they provide to nature and people. In fragmented ecosystems, wildlife corridors and other natural linkages such as green belts and large wildlife corridors (such as in Australia, Nepal and the USA) have been common representations of connectivity conservation. The scientific emphasis takes into account connectivity needs across landscapes and seascapes, and in some cases even across continents, where necessary to maintain or restore specific linkages for habitat or species populations, or to maintain or restore important ecosystem processes. Scientific study and conservation practice have made important strides in understanding and applying connectivity conservation across a range of scales and functions. In contrast, the role of law in connectivity conservation is still in very early stages of development. This paper begins to address these legal aspects. 5

The study of connectivity in the ecological and conservation sense emerged in the 1970s in response to increasing fragmentation of landscapes due to development. The resulting habitat degradation and loss posed serious threats to the survival of wild species and disruption of critical ecological processes such as the hydrologic cycle. Wildlife corridors, habitat patches, stepping stones, and other spatial linkages became tools for restoring natural linkages, connecting important habitats, facilitating species movement, and sustaining ecosystem functions in highly fragmented terrestrial, freshwater, and marine areas. The concept is recognized as an important design and management strategy to support biodiversity conservation and ecological processes in such areas and is applied to a range of spatial scales depending on need and feasibility. In application, much of the recent scientific research and literature on connectivity conservation has focused on its role in supporting protected areas as part of protected area systems and networks. This application provides a concrete focal point for studying the legal aspects of connectivity conservation and for framing much of the analyses provided in this paper. (Box 1 summarizes the current state of development of protected areas worldwide). 6

Box 1: Growth of protected areas and systems

Worldwide, protected areas have become a key strategy for conservation of biodiversity in all aspects, including the diversity of species, genes, and ecosystems. Since the 1960s, countries have made important strides in expanding their protected area systems especially in developing countries, in most cases with some form of legal protection. According to the latest global data on protected areas, by 2010 there were some 200,000 protected areas with legal recognition covering 12.7 per cent of the world's land area; this compared with about 1.5 per cent coverage in the 1960s (UN Millennium Development Goals web site, Report 2011). Despite this progress, however, scientific studies continue to show that biodiversity is being lost at significant rates. Important biodiversity sites in marine and coastal waters are even more threatened. In 2010, designated marine protected areas in 2010 covered only about 7.2 per cent of coastal waters (out to 12 nautical miles) and 3.5 per cent of exclusive economic zones, with overall ocean coverage less than 1.5 per cent.

Adding to the challenges of coverage, many existing protected areas are not effectively fulfilling their biodiversity objectives. They face serious on-site stresses such as poor management, pollution, illegal logging or fishing, introduction of invasive alien species, mineral extraction, and unsustainable visitor use. As population and development pressures have increased, many protected areas are facing even greater threats from outside their boundaries largely due to human-caused changes in land and marine use, degradation and fragmentation of supporting ecosystems, and loss of habitat linkages between protected areas. Overlaying these on-going stresses are impacts from climate change. Many scientists believe that climate change presents one of the greatest long-term threats to biodiversity. Climate change impacts are already being felt on ecosystems and species, and are expected to get worse. In recent decades, these concerns have focused attention on the need to better integrate protected areas into their wider landscapes and seascapes if they are to survive over the long-term and achieve their conservation objectives. Two major management approaches are being used to help achieve this goal: I) the ecosystem-based approach to protected areas design and management and 2) shifting emphasis from individual protected areas to protected area systems and networks. Each of these approaches triggers the need for connectivity conservation.

A protected areas system or network may be all of the protected areas of a nation, or its terrestrial or marine components, where applicable. As laid out in international guidance, new areas that may be added from time to time to strengthen the system should be established, where feasible, on the basis of scientific criteria including representativeness and adequacy of the site for the defined purposes, persistence to survive, and comprehensiveness (Lausche, 2011, p. 139). Protected area systems and networks are most successful if they are planned and managed using an ecosystem approach and with regard to the importance of their connectivity needs. The value of and benefits flowing from connectivity conservation in this context are enhanced by such planning and management.

7 Governments around the world are beginning to recognize connectivity conservation as an important management tool for integrating protected areas into wider landscapes and seascapes as part of protected area systems and networks. A new Strategic Plan for Biodiversity 2011-2020 adopted by the Parties to the CBD in 2010 reflects the most recent global biodiversity and protected area commitments (CBD COP 2010 X/2). These are set out in 5 strategic goals and 20 biodiversity targets called the Aichi Biodiversity Targets (for the Japan prefecture where adopted). While all the Aichi Targets have relevance for connectivity conservation, Target 11 is most explicit. It states:

> By 2020, at least 17 per cent of terrestrial and inland waters, and 10 per cent of coastal and marine areas, especially areas of particular importance for biodiversity and ecosystem services, are conserved through effectively and equitably managed, ecologically representative and well connected systems of protected areas and other effective area-based conservation measures, and integrated into the wider landscapes and seascapes" (Target 11, CBD Strategic Plan 2011-2020).

8 To achieve these global biodiversity targets, planning and management decisions for connectivity conservation need legal support. There has been little conceptual work to understand legal issues and potential legal approaches to support connectivity conservation on the ground. Within the field of law, the concept of connectivity conservation is still being defined and developed.

Purpose and scope

9 The purpose of this concept paper is to explore legal aspects of connectivity conservation for achieving biodiversity conservation and supporting the goals of protected areas. In light of climate change, the analyses also consider the role of connectivity conservation for building natural resilience of protected areas and for climate change adaptation and mitigation. The document reflects conceptual work undertaken during 2011-2012 by a protected areas and climate change expert group formed by the IUCN Environmental Law Centre (ELC) for the project: "Protected areas law at the intersection of biodiversity conservation and climate change". Undertaken by ELC in collaboration with members of IUCN's WCEL, WCPA, and GPAP, the project is believed to be among the first legal studies looking specifically at legal mechanisms for connectivity conservation.

Because connectivity conservation may be needed at a range of geographic scales, from large scale and regional to local, the scope of this paper extends to three levels of law relevant for connectivity conservation in terrestrial, freshwater, and marine ecosystems, as well as the natural connectivity needs between land, sea, and air: 10

- International level – relevant treaties and programmes that may set out global obligations, commitments, or guidance, including under CBD and UNFCCC mechanisms, for countries to support connectivity conservation in the context of their protected area systems and networks;
- Regional level – continent-wide, multi-country and transnational level initiatives, including European Union directives and Pan-European initiatives, and lessons being learned with regional agreements and programmes requiring or promoting connectivity conservation;
- National/subnational level – legal instruments and related tools useful to help achieve connectivity conservation at a country level and at provincial, state, and local levels to the extent to which conservation authority exists.

At the national/subnational level, the legal tools that may be available for connectivity conservation range from direct regulation requiring implementation to incentives and other economic instruments promoting implementation through voluntary action. In addition, the substantive legal instruments relevant for connectivity may be viewed in two main dimensions: 11

- **Legal aspects directly tied to the protected area systems and networks** – national/subnational protected areas legislation is a key area of law for addressing this dimension. *The IUCN Guidelines on Protected Areas Legislation* identify several elements important to address in protected areas legal frameworks to support connectivity conservation needs of the protected area system and individual protected areas in that system. These include protected areas system planning and design, management planning for specific sites, buffer zones, EIA requirements, and achieving specific biodiversity objectives where integration in the broader landscape and seascape and, in some cases, formation of ecological networks (for example, for terrestrial and marine migratory species) are crucial ;
- **Legal aspects external to protected area systems and networks** – an array of other substantive laws are important to consider. These range from conservation and sustainable resource use laws (for example, for wildlife, forests, fisheries) to land use and development control laws. Connectivity conservation outside protected areas will involve mostly non-state owned or non-state controlled lands and resources. A wide range of land tenure systems and rightsholders, including local communities and indigenous peoples, NGOs, private individuals and corporations, will likely have controlling interests in how lands identified for connectivity conservation are managed. The larger the landscape or seascape under consideration, the more likely there will be a combination of interests. This dimension normally is not within the primary scope of protected areas legislation.

Approach

The approach used for preparing this paper has been for the authors to undertake research and conceptual analyses of various legal instruments in their areas of expertise that may be relevant for connectivity conservation, from international to national/subnational law. As noted above, connectivity conservation is a new area for law and much work still needs to be done to understand possibilities using current and new legal tools, particularly in developing country situations. Thus, a conceptual approach to the topic provides the opportunity to explore a wide range of instruments for their potential as well as shortcomings for connectivity conservation. This paper is intended to provide a conceptual 12

platform for more in-depth work, including specific case studies, to further define and develop this area of law.

13 The paper also is intended to complement and supplement the *IUCN Guidelines for Protected Areas Legislation* (Lausche, 2011). Those Guidelines, accompanied by 15 case studies, identify key legal elements for modern protected areas legal frameworks, including several elements for connectivity conservation. These elements include provisions for management plans, buffer zones, connectivity corridors, climate change adaptation, environmental impact assessment, monitoring, and evaluation. The Guidelines provide a foundation and starting point for considering the legal aspects of connectivity conservation in more depth than was possible through that project.

14 In addition, the paper is intended to complement *Connectivity Conservation Management: A Global Guide* published by IUCN in 2010 (Worboys et al., 2010). That publication synthesizes the latest scientific information on connectivity conservation, provides several examples of large-scale connectivity conservation initiatives worldwide, and lays out a comprehensive management framework of key tasks for connectivity conservation management. Regulatory instruments and enabling legislation for economic instruments are recognized as necessary components with two main functions: l) to set out the authority and obligations for planning and managing connectivity conservation and 2) to provide standards, other legal tools, and incentives needed or useful to fulfil those obligations on the ground.

15 Two generic terms are used frequently throughout the paper with special meaning:

- **Landholder** is used broadly to refer to an individual, group, corporate body (such as a commercial entity or NGO), or indigenous or local community that has full rights of ownership over the land (**landowner**) or has exclusive rights to use particular natural resources, for example, the forests, fisheries, grasslands, or other products of nature (**rightsholder**). These rights may be legally grounded in statutory legislation, a lease or other long-term contractual arrangement, or customary law. When used generally in this paper, the term landholder also includes rightsholders. In some cases, the term 'landowner' is specifically used to indicate that the discussion is confined to this particular category of landholder. The term 'rightsholder' is particularly applicable to marine areas where government has overall jurisdiction but a non-governmental entity may have exclusive resource use rights, for example, an indigenous or local community with rights to a fishery or fishing grounds.
- **Legal instrument** is used broadly to cover legislation such as national laws or acts, executive decrees, or executive orders, as well as supporting subsidiary instruments such as regulations, rules, norms and other tools with legal effect (for example, contracts). It includes all instruments that are designed to influence behaviour which are recognised in law, including not only direct regulation but also economic instruments and voluntary agreements.

Audience

16 This paper is aimed at a wide audience, from policy makers and law practitioners, protected area managers and planners to a general readership. The intended audience may include international organisations working with connectivity (for example, secretariats of multilateral environmental agreements such as the CBD and UNFCCC), conservation NGOs, local communities, indigenous peoples, and private sector interests with ownership or use rights. *The IUCN Guidelines for Protected Areas Legislation* and this associated paper, taken together, also are intended to be useful as teaching and training materials at university and practitioner levels, through such means as formal courses, E-learning tools, and special training workshops and seminars. Finally, as much as possible, every effort has been made to write the paper in a non-technical, reader-friendly style for the general public.

Organisation

17 The paper is organized in two main Parts. These Parts are further divided into sections. Part I sets out basic concepts and principles related to connectivity conservation that are important to take into account for supportive legal instruments. Section 1 provides an overview of the state of scientific knowledge and management principles underpinning effective connectivity conservation measures on the ground. Section 2 reviews key benefits that may flow from effective connectivity conservation initiatives, including co-benefits for both biodiversity and climate change strategies. International initiatives through the REDD/REDD+ programme of the UNFCCC are also reviewed in this context. Section 3 reviews core governance principles and related considerations important for public policy and decision-making of governments generally, and gives special focus to their application to connectivity conservation.

18 Part II turns to legal aspects of connectivity conservation, and is divided into four sections. The Part begins in Section 1 with a discussion of international law instruments of global scope which directly or indirectly promote connectivity conservation. Section 2 reviews selected legal instruments of regional and supranational scope, including EU legal instruments (Directives) relating to Natura 2000, a continent-wide European ecological network among the 27 Member States. These discussions are mostly in the context of terrestrial environments, although many general obligations and principles apply also to seascapes. Selected international law instruments important for connectivity conservation in marine environments are reviewed in the last section of Part II which deals with special issues for marine connectivity conservation (see Part II, section 4, below).

19 The third section of Part II turns to national/subnational legal instruments relevant for connectivity conservation, either directly or indirectly. It is the largest section of this paper, covering an array of legal instruments, from conservation and land use laws to market-based programmes. Since national legal systems differ from country to country, the legal tools and options available and appropriate for connectivity conservation may vary widely. For this reason, it is not possible to be exhaustive in the review. The aim is to highlight major instruments and issues important to consider when putting in place legal frameworks supporting connectivity conservation.

20 This section begins with background on the variety of law and policy tools available to most governments for policy implementation in general. It gives particular attention to the role of direct regulation as compared to the use of economic instruments to give incentives for achieving connectivity conservation actions. The section then turns to specific areas of law. Because of the diverse and wide range of possibilities, the section is divided into five subsections (3.1 to 3.5), each dealing with a distinct legal theme. Section 3.1 focuses on conservation and sustainable resource use instruments which have requirements that make connectivity conservation necessary or provide direct mechanisms to achieve it. Section 3.2 shifts to land use planning legislation, a major field of law in many countries, especially developed countries. Land use strategies, land use plans and zoning, while not principally directed to conservation, play an important role in guiding and controlling how non-state lands and related resources are developed. Section 3.3 moves on to development control laws and their potential for supporting connectivity conservation.

21 In Part II, sections 3.1 through 3.3 deal with legal instruments that are largely implemented through direct regulation. In contrast, section 3.4 turns to instruments for promoting voluntary actions and, specifically, voluntary conservation agreements. Finally, section 3.5 highlights a variety of economic instruments useful for promoting or reinforcing voluntary actions by landholders for connectivity conservation, from financial incentives and direct funding support to market-based programmes.

22 Part II closes, in section 4, with a discussion of special connectivity conservation considerations for sustaining marine biodiversity areas and species, including through marine protected areas (MPAs) networks. The section highlights special features of the marine environment and some of the key management and governance frameworks that are emerging in response, such as marine spatial planning, ocean zoning, and integrated coastal and marine management.

23 The paper concludes by offering several key messages that have been drawn from the conceptual research and analyses undertaken for the project and reflected herein. These messages have been singled out to provide a baseline or platform for further research and case studies in law and connectivity conservation. It also is intended that the paper and these key messages will be of use to countries and organisations already taking steps to build or strengthen their legal frameworks for connectivity conservation.

Part I – Basic principles and concepts for understanding connectivity conservation

Introduction

Connectivity conservation is an important conservation tool in the field of nature conservation. The ‘connectivity’ aspect of connectivity conservation has two main components: the natural function that needs to be maintained or restored and the physical space required for that function to occur (Crooks and Sanjayan, 2006). In that sense, connectivity conservation relates to maintaining the functional integrity of natural ecosystems and essential ecosystem processes, which includes the specific spatial arrangements and elements needed to allow for connectivity (for example, a river, forest, coastal zone, coral reef) and the natural movement across their distribution ranges of species and species populations. A landscape/seascape or local or regional site will have different connectivity functions and spatial considerations depending on the role of that site for the targeted or affected wildlife, for example, from small-scale areas for small sedentary animals or important plant populations, to large-scale landscapes/seascapes, regions, or transcontinental areas for wide-ranging birds, or large mammals. To illustrate further, connectivity measures will need to focus on the site-specific level where a road divides a population of frogs, or on a much larger scale for the migratory routes of elephants across adjacent countries, bird flyways from Eurasia to Africa, or marine mammal life cycle migrations across the planet’s oceans. 24

Today, there is a substantial body of study in connectivity conservation science and management practice. Connectivity conservation is becoming an accepted field of science and is recognized as essential to the maintenance of biodiversity, but this is a relatively new development (Chester and Hilty, 2010). Its scientific foundations come principally from the fields of conservation biology, ecology, population dynamics and genetics. The science is dynamic and continues to be defined and expanded through theoretical studies, modeling, applied experiments, and experience in the field. 25

This Part gives an overview of key principles of connectivity conservation science and management as background for considering legal issues, tools, and approaches for providing the necessary legal capacity to implement connectivity conservation. It begins by highlighting connectivity conservation scientific and management concepts guiding present-day application on the ground. It then reviews key benefits of effective connectivity conservation, giving particular attention to the co-benefits of connectivity for both biodiversity conservation and climate change adaptation and mitigation. The Part closes with a brief discussion of special governance considerations that arise when planning, designing, and implementing connectivity actions on the ground. 26

1 Science and management

There is a large and growing body of scientific literature on biological, ecological, and applied research related to connectivity conservation and how it functions for biodiversity conservation and ecosystem maintenance. A number of recent publications are very helpful in synthesizing results of these many studies and giving a sense of the current state of scientific knowledge about connectivity. These books and reports (see Table I(1)-1 below) have been especially valuable sources of information for the science and management discussions to follow, and also have been helpful for much of the discussion in Part II on legal aspects. 27

Table I(1)-1: Major sources of synthesized information on connectivity conservation

Title	Date	Editors	Authors	Publisher	Case studies	Comments
Assessment & Planning for Ecological Connectivity: A Practical Guide	2011		Keith Aune, Paul Beier, Jodi Hilty and Fraser Shilling	The Wildlife Conservation Society	No	78 pp.
Connectivity Conservation Management: A Global Guide (with particular reference to mountain connectivity conservation	2010	Graeme L. Worboys, Wendy L. Francis, Michael Lockwood	The editors, plus other chapter authors, Charles C. Chester and Jodie A. Hilty, and case study contributing authors	Earthscan	Yes, from around the world	IUCN-WCPA project, 381 pp.
Australia's Biodiversity and Climate Change	2009	–	Will Steffen, Andrew A. Burbidge, Lesley Hughes, Roger Kitching, David Lindenmayer, Warren Musgrave, Mark Stafford Smith, Patricia A. Werner	CSIRP Publishing, Australia	Uses Australia as case study; broad application	Links ecological conservation principles with connectivity conservation and climate change, 236 pp.
Connectivity Conservation	2006	Keven R. Crooks & M. Sanjayan	More than 50 contributors, 26 chapters	Cambridge University Press	No	Collection of technical articles in Conservation Biology, 712 pp.
Habitat Fragmentation and Landscape Change: An Ecological and Conservation Synthesis	2006	–	David B. Lindenmayer and Joern Fischer	Island Press	No	Collection of articles on landscape ecology science, 21 chapter, 329 pp.
Corridor Ecology: The Science and Practice of Linking Landscapes for Biodiversity Conservation	2006	–	Jodi A. Hilty, William Z. Lidicker Jr., and Adina M. Merenlender	Island Press	No	The science of corridors and connectivity, and how practical application, 9 chapters, 323 pp.
Review of Experience with Ecology Networks, Corridors and Buffer Zones	2006	–	Graham Bennett and Kalemani J. Mulongoy	CBD, CBD Technical Series No. 23	Yes, five UN regions	Important discussion of ecological concepts, discusses global experience, 97 pp.
Applying Nature's Design: Corridors as a Strategy for Biodiversity Conservation.	2006	–	Anderson, A. B., and C. N. Jenkins	Columbia University Press, New York	Yes, nine cases	231 pp.

Linkages in the Landscape: The Role of Corridors and Connectivity in Wildlife Conservation	2003	––	Andrew F. Bennett	IUCN	Yes, five case studies	Covers principles, corridors, shift to connectivity; 151 pp.

1.1 Connectivity Conservation Science

1.1.1 Conceptual foundation

Scientific literature ties the beginnings of connectivity science to the 1960's work of prominent socio- 28
biologist and biodiversity conservation Edward O. Wilson. Wilson collaborated with mathematician and ecologist Robert MacArthur to attempt to apply the theory of species equilibrium to the contained environment of small islands. The resulting book, The Theory of Island Biogeography (MacArthur and Wilson, 1967), is now a standard work of ecology and informs conservation policy and the planning of nature reserves and other protected areas around the world. Wilson and MacArthur effectively demonstrated the theory that species composition, richness, and survival were affected by both the size and isolation of islands. Larger islands gave species a higher probability of colonizing and survival because of more habitat for migration. They had the potential to contain a greater diversity of species and larger populations of each, thereby increasing the possibility of interactions among species and decreasing the possibility of inbreeding and loss of genetic diversity. Proximity to other islands or the mainland also reduced rates of extinction when species were able to migrate and recolonize in those nearby areas, thereby increasing the rate of colonisation by new species, or re-establishing those that had become locally extinct. The arrival of new individuals could increase the genetic diversity of existing populations.

In the 1970s, biologists generalized the theory of island biogeography to isolated patches of terrestrial 29
habitat (for example, mountains surrounded by deserts, lakes surrounded by dry land, forests in agricultural landscapes, and even protected areas surrounded by converted landscapes. This led to research on fragmentation which generated more theories and concepts (Lindenmayer and Fischer, 2006, p. 32; see generally Worboys et al., 2010).

An important concept that developed from this continuing research was the theory of 'metapopulations'. 30
A population of the same species that survives in a series of disconnected habitat patches is known as a "metapopulation". The theory of metapopulations is concerned about the fate of a single species in contrast to the theory of island biogeography which focusses on the total number of species. Within a metapopulation, there are 'sub-populations'. To define connectivity conservation needs of a particular area using this theory, scientists and managers focus on a single species as it may occur naturally in a series of local sub-populations. In fragmented landscapes, these sub-populations may occupy patches of suitable habitat but be separated from similar sub-populations by degraded areas. Studies have shown that such sub-populations are at a greater risk of extinction through disturbance and inbreeding (Bennett, 2003, p. 40). Together, however, such a set of sub-populations form a regional population. If breeding individuals can be exchanged among the various sub-populations, genetic diversity can be maintained and the 'metapopulation' can be protected from disturbances that could wipe out one of the smaller sub-populations. Connectivity conservation can do that by providing linkages across the landscape/seascape to facilitate sufficient movement between sub-populations to supplement declines, increase genetic diversity, and recolonize at a rate faster than the rate of extinction. This

approach, if used effectively, can make up one large population again that has a higher probability of persistence over time.

31 Today, the metapopulations concept is a main theoretical basis for understanding the need for connectivity of plant and animal populations in fragmented environments (Bennett, 2003, p. 42). These species populations are what make up species communities and ecosystems at the landscape/seascape scale. This means that, at a broader level, investment in connectivity is an important remedy for the wide-scale degradation and fragmentation of ecosystems and an important tool for avoiding the isolation of protected areas in those landscapes and seascapes. For this reason, the metapopulation approach has become a prominent option in conservation strategies and action plans (see, for example, the Action Plan and Recommendations from the Vth IUCN-WCPA World Parks Congress in 2004 which had as its theme 'benefits beyond boundaries'). Many of these aspects have been taken up in decisions of the Parties to the Convention on Biological Diversity.

32 **Concepts from landscape ecology.** By the early 1980s, the science of landscape ecology had become an established discipline. Conservation biologists saw this as a new tool for connectivity studies because the discipline considered entire landscapes and elements within entire landscapes instead of just specific 'hotspots', species or habitats (Crooks and Sanjayan, 2006). Landscape ecology also could take into account the spread of disturbances (for example, fire, pests) and movement of processes (for example, water and flows), rather than just species, and the impacts from human influences (Pfund et al., p.300).

33 Landscape ecology created new terms and concepts which remain in use today in the connectivity literature (Lindenmayer and Fischer 2006). Among these were four terms from which connectivity conservation science has evolved: 'patch', 'corridor', 'matrix', and 'mosaic' (sometimes referred to as the patch-corridor-matrix model). Because they are still actively used, including in some legal contexts, it is worthwhile to briefly discuss them here. (See Figures I-1 and I-2 below for schematic representations.)

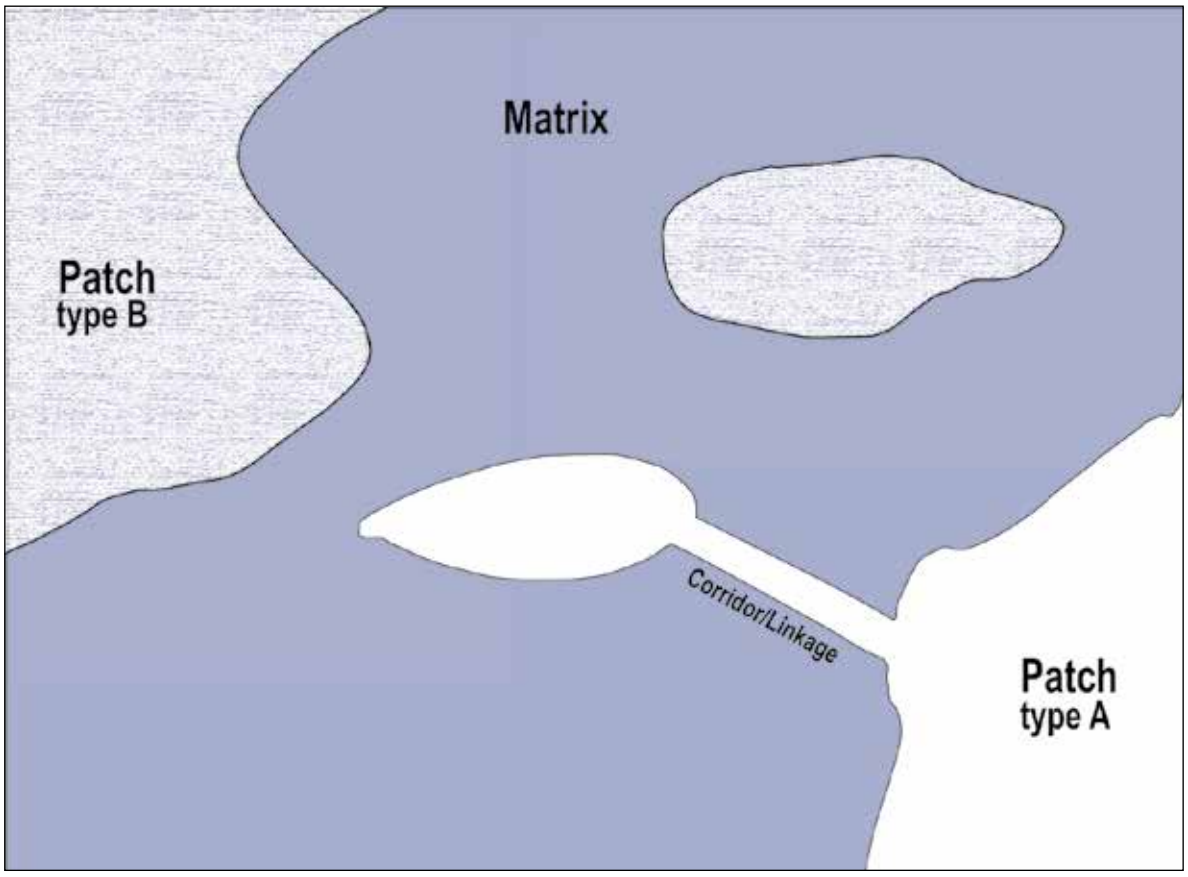
Patch: is a fundamental term in landscape ecology. It is a relatively homogeneous area that differs from its surroundings and is considered the basic unit of the landscape (Forman 1995). A patch has a definite shape and can be described by natural or other features, for example, areas of oak woodland, grassland, and residential development are examples of patches within a landscape. The terms 'habitat patches' or 'natural resource patches' are commonly used in the context of habitat fragmentation and connectivity. A related term is 'stepping stone' meaning one or more separate patches of habitat in the space between core protected areas that provide resources and assists animals to move through the landscape (Bennett 2003, p.10). Patches may be due to natural factors (soil type) or human factors (development).

Corridor: originally the term was used in landscape ecology to mean a strip of land or water that differed from the adjacent land on both sides and could have several important functions (including conveyance, barrier, and habitat) (Forman 1995). The idea of corridors to link otherwise isolated habitats was one of the earliest practical recommendations arising from studies of habitat fragmentation (Bennett 2003, p. 4). Scientists debated the functional value of corridors in part because of difficulties of definition, measuring effectiveness and, in many cases, the small spatial area covered. Today, these debates are considered largely over (Worboys and Pulsford, 2011). In the 2000s, terminology shifted from corridors to connectivity, and such terms such as 'link' or 'linkages', to better incorporate broader ecological principles and nonlinear approaches (Bennett 2003, p. 9; Chester and Hilty 2010, p. 24; Steffen et al., 2009, Worboys 2010). However, the term 'corridor' can still be found in policy and law in many countries, as will be discussed more in Part II.

Matrix: the background ecosystem or land-use type in which patches, corridors and other linkages are located. Many of these areas are semi-natural lands that may be managed primarily for farming, timber, recreation or other human uses, but provide extensive cover and high connectivity (Forman 1995). Matrix lands that are more human-dominated (urban or residential areas) have less potential for connectivity and may even be barriers to movement. In conservation management, the goal is for matrix areas to provide some connectivity benefits overall and also to support the patches and linkages within the area. These benefits could include adding habitat for certain species, facilitating species movement between habitat patches, and serving as buffers for core habitat areas (Forman 1995; Defenders of Wildlife 2011, Center for Large Landscape Conservation 2010).

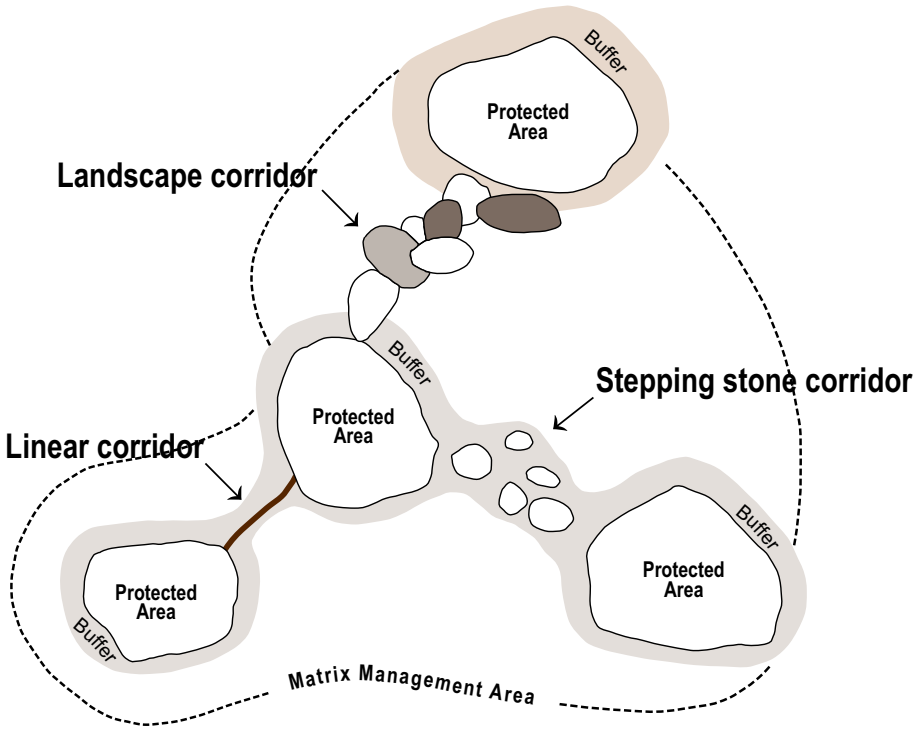
Mosaic: the concepts of patch, matric, corridors, linkages are often discussed in scientific literature within the context of the broader landscape 'mosaic', or the overall pattern of these components and other natural features that form a landscape in its entirety (Forman 1995). Natural features of a landscape include such elements as the dominant vegetation, soils, topography, microclimate, natural disturbance activities such as flooding, fire, wind, insect or animal infestations. These features occur intermixed, creating a pattern or 'mosaic' used by wildlife and ecosystem processes in daily, annual or longer cycles.

Figure I(1)-1: Illustration of Patch-Corridor-Matrix Model



Source: Adapted from Lindenmayer and Fischer 2006, p. 34

Figure I(1)-2: Linear, stepping stone and landscape corridors linking core areas



Source: Chester and Hilty, 2010, p. 25; from Bennett 2004.

1.1.2 Connectivity conservation today

34 In present-day science, connectivity is widely recognized as a key component of nature conservation and a requirement for effective protected area systems and networks (Crooks and Sanjayan 2006). It is a central theme in conservation biology and terrestrial landscape ecology and also appears in conservation management guides for modern protected areas networks (for example, see Lockwood et al., 2006; Worboys et al., 2005). Connectivity has gained attention particularly for its potential to reverse the accelerating rates of biodiversity loss. As observed in one article:

> Given the dual deleterious trends of increasing habitat fragmentation and climate change, biologists, scientists and managers have increasingly turned to the potential of connectivity conservation areas in protecting biodiversity. Indeed, it may only be a matter of time before 'connectivity ecology' becomes as familiar an endeavor as, say, 'forest ecology'. (Chester and Hilty 2010, p. 23 in Worboys et al., 2010)

35 To begin the discussion of connectivity science, Box I(1)-1 reviews some key terms used in biology and ecology that are important to understand when researching and developing legal tools.

Box I(1)-1: Key ecological terms

Some foundation terms used in biology and ecology are important to understand when designing legal instruments for connectivity conservation because these instruments may need to adopt the terms. They include:

Biological diversity or biodiversity: using the CBD definition means the variability among living organisms from all sources including, among other things, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are a part, and diversity within species, between species and of ecosystems (CBD, Art. 2). Monitoring the components of biodiversity requires several levels of organization: regional landscape, community-ecosystem, population-species, and genetic (Noss 1990).

Ecological processes: biological, physical, and chemical processes that sustain ecological systems and life as we know it. These processes include water flows and movement, nutrient recycling, sediment movement and predator-prey (food chain) relationships. Ecological processes are part of a functioning ecosystem and together with the physical conditions present (depth of water, soil type, temperature of air)) make up the ecological function of an area. Collectively, ecological processes produce organic matter using energy through photosynthesis and chemosynthesis, transfer carbon and nutrients through food webs and through decomposition, drive soil formation, and enable the production of organisms, for example, by pollination of plants by insects. Ecological processes influence the extent, distribution and biodiversity of systems.

Ecological (ecosystem) goods and services: these are the benefits arising from the ecological functions of healthy ecosystems that are essential to life of all living organisms (plants, animals, humans), and also provide social, cultural and economic value to humans. Examples of ecological goods include clean air, and abundant fresh water. Examples of ecological services include purification of air and water, maintenance of biodiversity, decomposition of wastes, soil and vegetation generation and renewal, pollination of crops and natural vegetation, groundwater recharge, seed dispersal, greenhouse gas mitigation through carbon storage and aesthetically pleasing landscapes.

Ecological integrity: the condition of an ecosystem where the structure and function are unimpaired by human-caused stresses, and where the ecosystem biological diversity and supporting processes are likely to persist (Worboys et al., 2010).

Ecological network: system of nature reserves and their interconnections that make a fragmented natural system coherent to support more biological diversity than in its non-connected form, composed of core areas (usually protected), buffer zones, and ecological linkages connecting these, thus containing both natural and semi-natural landscape elements configured and manag ed to maintain or restore ecological functions as a means of conserving biodiversity while also providing opportunities for the sustainable use of natural resources. Also, sometimes called 'conservation network' or 'connectivity network'. (Center for Large Landscape Conservation, 2011; Bennett 2004, p. 6).

Ecological resilience: the capacity of a system to withstand changes to the processes that control its structures. As explained in the scientific literature, "[t]here is growing scientific understanding that disturbing ecosystems can reduce their resilience and result in dramatic shifts to less desirable states that weaken their capacity to provide ecosystem goods and services." This weakened state has financial implications. (Hilty et al 2006, p. 9-10).

Ecosystem: a dynamic complex of plant, animal and micro-organism communities and their non-living environment, interacting as a functional unit (CBD, Art. 2).

Ecosystem approach: according to the CBD, a strategy for the integrated management of land, water, and living resources that promotes conservation and sustainable use in an equitable way. The ecosystem approach is the primary framework for action under the CBD, and its application helps to reach a balance of the three objectives of the Convention: conservation; sustainable use; and the fair and equitable sharing of the benefits arising out of the utilization of genetic resources (CBD COP 2000 V/6, para. 7A-1). Both the ecosystem approach and ecological network concept focus on maintaining ecosystem functions for the long term and securing the sustainable use of the land and sea (Bennett and Mulongoy 2006, p. 9-10).

Habitat: an area which provides the combination of resources (like food, cover, water) and environmental conditions (temperature, precipitation, presence or absence of predators and competitors) that promotes occupancy by individuals of a given species (or populations) and allows those individuals to survive and reproduce; the application of this definition becomes defined by the particular species involved. (Franklin et al., 2022, p. 21)

Habitat fragmentation: the reduction and isolation of patches of natural environment, including landscape transformations that break large habitat into smaller pieces; the concept ultimately applies to the species level because habitat is defined with reference to a particular species. Fragmentation can come about naturally (for example, through fire, storms, or flooding) or by human actions (Franklin et al., 2002).

Species, species populations, and species communities: in simplest terms, species are the different kinds of organisms found on Earth; a particular species is defined as a group of organisms capable of interbreeding and producing fertile offspring. A species population is a group of individuals of the same species that live in the same geographical area. A species community refers to all the populations of species living in the same geographic area and interacting for such things as acquisition and use of food, space, and other resources, nutrient cycling and regulation of population size, and as predator and prey, producer and consumer, or competitor.

What is connectivity. The concept of connectivity for purposes of conservation has been defined in many publications. The one element that has been dominant in the scientific literature is linking habitats to enhance wildlife conservation (Bennett, 2003). At its most fundamental level, connectivity is inherently about the degree of movement of organisms or ecological processes: "…the more movement, the more connectivity. Perhaps even more critical for those committed to biodiversity conservation is the 36

converse – less movement, less connectivity" (Crooks and Sanjayan 2006, p. 2). From a landscape perspective, a simple way to think about connectivity is the degree to which the landscape facilitates species movement and other ecological flows (Clevenger and Wierzchowski, 2006, p. 505). Connectivity at a particular site or in a particular network is defined from the perspective of the specific organism, species, or process of interest (Grober-Dunsmore et al., 2009).

37 The book *Connectivity Conservation Management – A Global Guide,* a joint effort by IUCN WCPA and nine other institutions, also offers a characterization along these lines. (The reference below to 'non-local ecosystem functions' relates to those larger-scale ecosystem functions and ecological processes at the landscape/seascape or sometimes even the regional or continental level on which the integrity of the local ecosystem functions depend.)

> The term connectivity is a measure of the extent to which plants and animals can move between habitat patches, as well as the extent to which non-local ecosystem functions associated with soil and water processes, for example, are maintained (Worboys et al., 2010, p. 22).

38 **Types of connectivity.** Importantly, as background for looking at law and connectivity, all these characterizations are useful because of their common recognition that measures to maintain species connectivity include maintenance or restoration of associated ecosystems and ecological processes in the broader landscapes/seascapes/regions of which they are a part. To help illustrate this, the concept has been elaborated into four main types: landscape, habitat, ecological and evolutionary (see Table I (1)-2).

Table I(1)-2: Four types of connectivity

Type	Description
1. Landscape/seascape connectivity	A human view of the connectedness of patterns of vegetation and environmental flows cover within a landscape/seascape.
2. Habitat connectivity	The connectedness between patches of habitat that are suitable for a particular species; habitat patches could be quite localized, regional, continental or even global in scope for migratory species such as some birds and marine mammals.
3. Ecological connectivity	The connectedness of ecological processes across many scales of air, water, and land, includes processes relating to trophic relationships, disturbance processes and hydro-ecological flows.
4. Evolutionary process connectivity	Natural evolutionary processes, including genetic differentiation and evolutionary diversification of populations, that need suitable habitat on a large scale and connectivity to permit gene flow and range expansion – ultimately evolutionary processes may require the movement of some organisms over long distances; an increasingly important function in a period of global change, including climate change.
Source: Adapted from Worboys et al., 2010, which provides additional sources for each type	

39 **Patterns and processes important for connectivity.** In science, connectivity conservation is commonly analysed in two components or dimensions: i) the physical space, or the patterns of physical elements in the landscape that need connecting (wetlands, tree patches, lakes, streams), and ii) how the species or processes behave and use that physically connected space. These components are referred to as structural (or spatial) and functional (or behaviour) aspects of connectivity.

In application, one must understand both aspects in order to design effective connectivity areas. For example, migratory species may use and require different physical spaces in a landscape for breeding, feeding, nesting, raising young, etc. Similarly, the ecological processes of a watershed may require different upstream, recharge, downstream, and midstream flow considerations that are essential for understanding connectivity needs in order to maintain adequate water flows for human and natural communities. Understanding the particular ecosystem functions an area serves for connectivity purposes usually is more difficult than identifying the landscape elements that are or should be physically connected. Physical landscape features often can be identified and assessed to a significant extent using modern technologies such as satellite imaging, GIS, and remote sensing. 40

1.1.3 Addressing scale

Scale is the most defining aspect of a connectivity initiative and is influenced by the nature of the problem to be addressed, extent of existing barriers to connectivity, conservation objectives, specific species' needs, and the institutions involved (Hilty et al., 2006, p. 269) The project scale, in turn, influences the processes that can be maintained or restored. For example, large-scale connectivity may be required to facilitate large-animal migration, whereas plant pollination may be accommodated within a smaller connectivity network. 41

In connectivity science, scale refers to the spatial and temporal dimensions in which a species or process operates (Bennett, 2003; CLLC, 2011). The spatial scale relates to the geographic extent to which connectivity measures are needed to sustain a species or ecological process. The temporal scale relates to the time over which connectivity conservation needs to apply, for example, seasonal, annual or multi-year cycles – considerations essential for migratory connectivity. Both species and processes vary widely in the distances and timeframes associated with the requirements by which they survive or are sustained. This means that identifying the appropriate scale of the focal species or process is critical to designing successful connectivity management programs (CLLC 2011). 42

Spatial scale. Connectivity conservation covers a wide range of spatial situations, from small, site-specific linkages to large-scale and even continental concerns. This calls for differentiated approaches to design and management depending on the scale of the area, and associated economic and political structures and social and cultural conditions. The scientific literature broadly recognizes three different spatial levels for understanding and designing specific connectivity needs, especially for species: local, landscape, and regional or biogeographic levels. As noted in Table I(1)-3 below, local scale linkages range from hedgerows and roadsides to city parks, while regional or biogeographic scale linkages could include large configurations such as mountain ranges and migratory waterfowl wetlands. 43

Table I(1)-3: Different spatial scales for connectivity

Landscape configurations	Local scale (1 km)	Landscape scale (1-10s kms)	Regional or biogeographic scale (100-1000s kms)
Habitat corridor (linear linkage)	hedgerows; fencerows; streams; roadsides; forest corridors; underpasses; overpasses	rivers and associated riparian vegetation; broad links between reserves; coastlines	major river systems; mountain ranges; isthmus between land masses; coastal zones
Stepping stones (or stepping stone corridor)	patches of plants, small woods; plantations; chains of small wetlands	series of small reserves; woodland patches in farmland; urban parks	chains of islands in an archipelago; wetlands along waterfowl flight paths, alpine habitats along a mountain chain; coral reefs; seagrass beds

Habitat mosaic/landscape corridors	patchily cleared vegetation in farmland; mosaic of gardens, parks in cities	mosaics of regenerating and old-growth forest in forest blocks	regional soil mosaics supporting different vegetation communities; seas and ocean environments supporting migratory marine mammals throughout their life cycle, some on a global scale
Source: Adapted from Bennett, A.F., 2003, Table 4-2, p. 60; and Bennett G, 2004, p. 6.			

44 **Large-scale connectivity.** Recent scientific literature places increasing emphasis on the importance of large-scale geographic areas when determining overall connectivity goals because this scale permits the incorporation of broader ecosystem processes and long-term impacts, such as climate change. It is especially at the larger landscape, regional, or continental scales where connectivity considerations need to be reflected in national conservation strategies, conservation plans, and land use strategies and plans. For connectivity planning, large and high-quality habitats provide larger source populations and locations for species colonization, and more capacity to move and re-establish in new regions if current habitats become degraded (Hodgson et al., 2010). A broad ecological perspective requires large-scale corridors and other linkages with sufficient physical scope to encompass whole ecosystems, range shifts due to climate change, and biodiversity resilience through major life forms within which plant and animal communities exist (for example, temperate forest, tropical rainforest, coral reefs, alpine, savannah – sometimes called biomes or geographical bioregions). Small and medium-size corridors sited within larger connectivity frameworks can carry out the needed site-specific linkages.

45 IUCN-WCPA has focused mostly on large-scale connectivity – those areas with many degrees of latitude and many degrees of longitude – in order to better address the pervasive and growing threats to entire ecosystems and biodiversity. This focus may span regions or be continent-wide depending on the specific biomes or bioregions needing connectivity conservation. Mountain ranges are an important example where much attention has been given to large-scale connectivity conservation research, analysis, and management (Worboys et al., 2010). In large-scale connectivity conservation, the vast area being covered may have diverse uses, tenure arrangements, biophysical features, and connectivity needs depending on the variety of species and ecosystems under threat. For such large expanses, managers must consider not only gaps where connectivity has been broken or disrupted but also all forms of human activity and development that may be some of the main sources of such gaps. For dealing with threats and global change factors with such broad scope, very narrow corridors may function well for some species but not for the conservation of many species.

1.1.4 Connectivity for climate change

46 Climate change presents one of the greatest long-term threats to protected areas and biodiversity conservation and our way of life on the planet. Climate change effects include changes in temperature, precipitation, weather patterns and sea level rise (these are laid out graphically in Figure 1(2)-1 and further discussed in section 2 of this Part below). These effects impact forests, grasslands, wetlands, coral reefs and other ecosystems as well as the distribution and survival of different plants and animals. Environmental degradation may be wide-ranging, from desertification on the land to acidification of the oceans. There is growing scientific agreement that retaining as much high quality natural and semi-natural habitat as possible should remain a key focus for conservation especially with climate change (Hodgson et al., 2010). Scientific studies have shown that the majority of mobile species respond positively to corridors, even though use is at different rates and degrees, thus increasing the probability

of persistence of many organisms as the climate changes (Gilbert-Norton, et al., 2010; Haddad et al., 2010).

47 In the context of climate change, scientists and conservation organizations see connectivity as especially important given the uncertainty regarding how species will adapt (Wilderness Conservation Society, 2011). An increasingly recognized justification for connectivity conservation is to help reduce the negative effects of climate change on biodiversity and ecosystems by providing space and resilience for adaptation. Connectivity conservation areas are able to serve as valuable escape routes for species which need to move when local conditions become degraded. A well-designed system or network of protected areas, complete with adequate connectivity conservation needs, will allow species to move to other areas where conditions are more favourable, or will act as refuges for species that move in from other areas. Isolated protected areas will clearly be less able to allow for adaptation in this way.

48 Enhancing connectivity provides an adaptation strategy that is spatially clear and can be extensive in order to facilitate dispersal by many species simultaneously (Krosby et al., 2010). For instance, studies have found that expanding the ranges of trees and other habitat-forming species beyond the edges of their current ranges could increase the probability of effective range shifts in species that depend on the habitat those tree or plant species provide (Krosby et al., 2010). In addition, extending the ranges of such habitat-forming species to nearby locations where they are more likely to become established or persist, may reduce the probability of non-native species invasions associated with this migration (Krosby et al., 2010, p. 1687).

49 Connectivity conservation also has benefits for human adaptation to climate change. For example, well-managed watersheds help maintain water supplies for cities and agriculture. Protected coastal mangroves, wetlands, coral reefs and seagrass beds help buffer against sea level rise and storm surges. Intact forests help prevent soil loss and landslides. Well-managed rivers and streams are better able to deal with flooding and sedimentation. These are important ecosystem-based solutions for climate change adaptation that complement other hard infrastructure solutions and are largely dependent on maintaining well-connected ecosystems and protected areas.

50 Protected area systems and connectivity conservation areas (core sites and their connecting areas) may also play a role in climate change mitigation (Dudley et al., 2010). Many natural areas (forests, grasslands, seagrass beds, mangroves) are important reservoirs for carbon storage. Well-designed and managed measures for connectivity conservation in those areas will help sustain their carbon storage functions and reverse or prevent degradation which will make them carbon sources. Moreover, where consistent with their conservation purposes, connectivity areas can be designed in ways to capture additional carbon, for example, by restoring or protecting areas with natural or semi-natural vegetation. This applies to both terrestrial and marine environments.

51 The increased attention to natural ecosystems as carbon sinks is being recognized by the international community. Planning initiatives under the international climate change legal regime for REDD and more recently REDD+ have potential for supporting linkages between climate change and connectivity for biodiversity. Such planning is beginning to look at natural forests not only as carbon stocks and new forests as carbon sinks, but also as landscape elements that can support connectivity for biodiversity conservation and for maintaining essential ecosystem services. Scientists working in agroforestry already are stressing the importance of pursuing such co-benefit approaches in order to strengthen nature-based solutions for climate change mitigation that also serve as adaptation strategies for climate change (Stigter and Vishwavaram, 2011).

1.1.5 Issues of uncertainty

52 Scientific literature acknowledges that nature conservation and connectivity planning will always need to be based on less than complete information, reducing the ability to make accurate predictions regarding responses of species and ecological processes or to other changes across the landscape, including climate change (Hilty et al., 2006, p. 271). Of utmost concern, even for present-day planning, is understanding ecosystem resilience and what may be the full impacts of different kinds of human land use on biodiversity over time. This is partly because it is difficult to know the amount of disturbance that an ecosystem can withstand without changing its processes and the services it provides. There may be incremental changes that are not that noticeable, but the cumulative impacts may be significant and large scale.

53 The major element adding significant new uncertainty for conservation is climate change. Ecological networks and ecosystem processes will most likely change due to climate change and the extent of this change, and the impact on ecosystem resilience, are largely dependent on how much the climate continues to change and how fast. Whatever the impacts, the specific connectivity conservation goals and priorities by which a specific area is being managed will also need to change in response and will depend on the spatial and temporal scales chosen. For example, if the connectivity focus is species migration, one set of actions may be needed; whereas if the focus is habitat linkages in an entire watershed and surrounding area, the watershed perspective would define the needed changes (Hilty et al., 2006, p. 209).

54 There are also uncertainties about transferring information from small to large scale. Recent scientific research on the relationship between habitat area and habitat quality show that not all areas contribute to conservation to the same degree. Much of the research has been focused on individual species and particular habitat quality in particular sites, rather than on interactions of larger numbers of species and landscapes/seascapes. But there is growing scientific agreement on the need to assess connectivity priorities, even of a specific site, in the context of the larger-scale ecological framework. Similarly, scientists and managers are understanding better how to design large-scale connectivity areas, including continent-wide areas, by approaching assessments from the perspective of larger ecological functions, such as the entire watershed from which water is secured or the particular biome within which the specific protected area systems or networks are located. In most regions of the world the major biomes are relatively well defined. Coupling biomes with geographical regions to make bioregions can help define the priority landscapes/seascapes and plant and animal communities that need special conservation measures within that zone. South Africa and Australia are examples of countries which are taking a biome or bioregional approach to connectivity conservation planning and connectivity.

55 Another uncertainty is how current understanding about connectivity applies to ecosystem types that have not been as well studied. For instance, scientific research on fragmentation and connectivity has had a strong terrestrial emphasis and within that a strong emphasis on highly fragmented forest and woodland habitats in temperate zones. In recent years, tropical forest habitats have begun to receive increased attention. One of the challenges and uncertainties ahead is how well the ideas and theories already developed could apply to larger mixed landscapes, areas that may be less fragmented, and especially to marine and freshwater environments (discussed in Part II) (Crooks and Sanjayan 2006, p. 23).

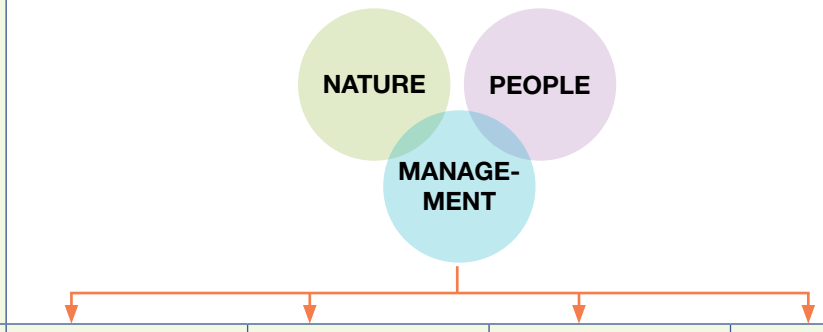
56 Scientific research continues in order to better understand ecological communities, ecosystem processes, complex biodiversity linkages, and the interactions between human and natural systems. As knowledge advances, management techniques improve on how to prevent or reduce habitat

fragmentation, restore and strengthen connectivity at different scales, and help communities and natural systems become more resilient to new threats and global change, including climate change.

1.2 Management concepts and tasks

Effective connectivity conservation requires that active management be guided by the best available science in order to identify, maintain and restore conservation linkages needed for protected areas systems and specific sites. It is important to have a management strategy that comprises analyses of both scientific elements and socio-economic institutions involved in order to ensure local participation in decisions about resource management and design of incentives that will be fair and acceptable to all parties. The book *Connectivity Conservation Management: A Global Guide* offers an illustration of the main management functions at different spatial scales important for implementing connectivity conservation at a national level and, potentially, at the level of many nations (see Worboys and Lockwood, 2010). This is reproduced in Figure I(1)-3 below. 57

Figure I(1)-3: Management framework for connectivity conservation at different spatial scales



Context Function / Four Management Functions/ Spatial Scale	Leading	Planing	Implementing	Evaluating
1. Entire connectivity area scale	Establish and sell the vision Establish the political, social and financial capacity to implement the vision Integrate the connectivity vision into the sectoral landscape	Develop a strategic plan for the whole of the connectivity conservation area	Achieve a capacity to operate Respond to critical connectivity area treaths	Establish evaluation needs and systems
2. National or state scale	Achieve government endorsement and support	Integrate the vision into national strategies for biodiversity and sustainable development	Implement responses to national issues such as climate change	Evaluate the performance of national implementation actions
3. Landscape scale	Achieve community support and facilitate multiple partnerships	Develop multiple cooperative task plans	Implement multiple cooperative tasks	Evaluate the performance of cooperative task

4. International transboundary scale	Facilitate a cooperative international partnership for the connectivity corridor	Establish a transboundary plan and MOU	Implement cooperative tasks	Identify international evaluation information needs and evaluate
5. Individual site level	Encourage individual "champions" and their initiatives	Facilitate individual project plans	Provide individual projects with support and assistance	Evaluate project management against objectives
Source: Worboys and Lockwood, 2010, in Worboys et al., 2010, p. 310				

58 The management discussion here highlights key concepts and tasks involved with planning and managing connectivity conservation where supportive legal elements are particularly important. These concepts underscore the critical need for active management across a range of tenures and scales if connectivity conservation is to be achieved and sustained.

59 **Planning for connectivity.** Strategic conservation planning should include planning for connectivity and linkages. Identifying and protecting linkages to support established protected areas and protected area systems and networks is particularly important where continued pressures are likely to be exerted on the surrounding natural environment. Establishing linkages takes time to negotiate and protect. During this process, critical connectivity areas may be lost. It is usually simpler, more cost-effective and ecologically more effective to identify and protect natural areas before they are lost or fragmented by planned or unplanned development, than to attempt to restore connectivity afterwards (Bennett, 2003, p. 151).

60 It is critical when planning for conservation and connectivity to engage all relevant sectors and interests in order to harmonize actions and have a holistic approach to conservation and development. For example, the maintenance of crucial watersheds to support human communities also has the important benefit of helping support plant and animal populations dependent on that watershed. Development plans, projects and processes that incorporate conservation benefits and ecosystem services upon which people and nature depend also is critical. Maintaining dune ecosystems, for example, along a coastline instead of converting the coast to other development uses helps protect local communities from the effects of coastal storms, maintain ecosystem conditions that may support a coastal fishery, and also protect habitat for a threatened species.

61 Overall, conservation planning needs to be strategic both in the present and future context, in order to plan how future connectivity needs of natural areas will be achieved. To the extent feasible, such planning considerations also should be taken into account in national/subnational land use plans and in development control instruments, including EIAs (see Part II, section 3.2 and 3.4). Incorporating connectivity concerns into conservation and land use normally will be an important aspect for advancing national policies and goals associated with such broad commitments as biodiversity conservation, climate change adaptation, and sustainable development. Connectivity planning should be required as part of broader planning. However, even where there may not be formal legal requirements to integrate connectivity in planning processes, these broader objectives need to include connectivity if they are to be achieved.

62 **Connectivity conservation area.** Connectivity conservation area is a generic term introduced in recent scientific literature for land/sea areas actively managed for connectivity conservation (Worboys et al., 2010, p. 4). The intention is to use 'connectivity conservation area' (or simply connectivity area)

to avoid confusion with other related terms, such as 'protected area', and also to distinguish the field and its broader scope from the original uses of the term corridor which were more linear and focussed on wildlife, principally animal populations. Today, the term corridor continues to be an important spatial tool, among a suite of tools being developed, to support connectivity conservation.

Connectivity conservation areas are meant to support the integrity and function of formal protected areas and biodiversity conservation but are not themselves protected areas. Connectivity conservation areas may be at different scales, depending on the conservation need. As indicated in Table I(1)-3 above, small scale connectivity conservation areas may be hedgerows, fencerows, streams, small woods, patches of plants, greenbelts, or a mosaic of gardens and parks in cities. Large-scale connectivity conservation areas may span large landscapes/seascapes, regions, or even continents with a range of different landowners, rightsholders, land tenures and land uses, and include national or transnational rivers, coastal zones, seas and oceans. 63

As discussed earlier in relation to scale, in recent years there has been increased emphasis on the importance of large-scale geographic areas when determining overall connectivity goals in order to incorporate broader ecosystem processes and long-term impacts, such as climate change. With that purpose in mind, one may characterize a large-scale connectivity conservation area as a predominantly natural area and a working landscape/seascape serving connectivity functions for protected areas and related biodiversity conservation goals that may include: 64

- extensive natural and semi-natural lands that provide interconnected linkages and stepping stones for wildlife;
- generally smaller areas of developed or degraded lands that create gaps in connectivity and could therefore be targeted for restoration or rehabilitation works (Hilty and Chester 2010, p. 25).

Defining the connectivity conservation area. Developing a management strategy for connectivity conservation begins by defining the connectivity area that needs to be managed. As emphasized in scientific literature, designing and evaluating connectivity actions for specific areas must be guided by the connectivity conservation goal, where relevant, related as well to the specific assets and needs of the protected area system or network (Kareiva, in Crooks, 2006; Hansen and DeFries, 2007). If the goal is to protect certain native or migratory species, then the connectivity needs should be defined by the habitat and linkages for movement between habitats in order to avoid extinction of the species, and where feasible strengthen the species population or community so it is not so vulnerable to the effects of fragmentation. In some instances there may be a 'flagship' species around which public support for connectivity conservation may be built. For example, the preservation of the spectacular jaguar (*Panthera onca*) is the main target of the Mesoamerica Biological Corridor, a vast interconnected network of protected and non-protected areas officially launched in 1997 by the seven Central American countries and Mexico. It also is important to understand the vulnerabilities of associated protected area systems and networks to impacts from surrounding land/marine uses and design buffers, linkages and management approaches to compensate for those vulnerabilities and strengthen the ability of the systems or networks themselves to achieve their biodiversity goals (Hansen and DeFries, 2007; DeFries et al., 2007). 65

Once connectivity objectives are identified, it is necessary to determine where connectivity matters most. This concerns the physical space in a landscape or seascape within which the connectivity linkages are needed. It is essential to plan all important connectivity linkages serving the conservation objectives and reflect these on a map in order that other sector agencies, land use planners, private section developers, landholders, landowners, rights-holders, other stakeholders or the interested public 66

are fully informed so they can meaningful participate in developing a plan, vision, and management framework based on existing and potential capacities and resources. These are science-based assessments.

67 **Understanding the socio-economic and cultural context.** There is consensus on the need to give a human context to connectivity conservation since such areas must function in a human context as well as a natural one. Socio-economic factors have a significant role in deciding which conservation priorities are economically or politically feasible. There may be times when it would be beneficial to alter the size and arrangement of a particular area of a landscape to restore linkages in habitat or natural processes that have been broken, but this action may be prevented or made more difficult by economic, social, or political constraints (Crooks and Sanjayan 2006, p. 37). When different spatial configurations of a connectivity conservation area are able to achieve conservation goals, socio-economic considerations should be taken into account in order to lower the level of protection constraints on human activities.

68 At the same time, certain cultural factors may aid and reinforce connectivity conservation initiatives. For example, there may be important sacred or other cultural natural sites in a proposed connectivity conservation area which also are protecting wildlife and ecosystem services. Local communities, groups and individuals that value the cultural or spiritual aspects of such sites may welcome their inclusion in connectivity conservation areas for the protections that may provide so long as reasonable access to and use of the site for cultural purposes is preserved. These are elements for negotiation that may help enhance local support.

69 Where a connectivity conservation area has working landscapes (for example, resource harvesting or agriculture), an important consideration is whether those activities sustain or enhance overall connectivity, or potentially harm connectivity and contribute to fragmentation of critical species habitats or ecological processes. In most situations, initiatives by private and community landholders to undertake active management measures on their lands for connectivity should be voluntary. This is in contrast to situations where there is an overwhelming public interest at stake, making it reasonable to require landholders to comply with public laws (for example, regarding pollution control, fire or pest prevention, or invasive species control).

70 Where private or community lands or resource rights are involved, consultation with and participation of the landholder is essential to help the landholder understand the role and value of the land for connectivity, possible modifications of existing practices that could support connectivity, incentives that might be available, and tools such as voluntary conservation agreements that may be used to set out rights and responsibilities of all parties (see Part II, section 3.4, below). The goal is to negotiate a fair and equitable arrangement that is both voluntary and balances human needs and conservation priorities.

71 In situations where existing land use practices, such as animal grazing or harvesting, should be reduced or eliminated, incentives in the form of alternative sites or income-generating activities may be an important or necessary aspect of any voluntary negotiation and final arrangement, especially where there is serious poverty. Alternative jobs and other incentives should be relatively equivalent to what is being foregone, or the agreement may be difficult to implement and socio-economic pressures may force harvesters into continued exploitation. This may occur even where those activities are illegal and the resources are already depleted (Mora and Sale, 2011).

72 As discussed in Part I-3 below, a general rule for effective connectivity conservation is the full application of good governance principles. This includes participation, information sharing, and fair and equitable sharing of costs and benefits among all affected Parties

Building conservation awareness and collaboration. Once the socio-economic context is understood, another core element of an effective management strategy is to build conservation awareness amongst the local affected peoples and communities. This involves identifying and understanding, as best possible, the main human uses, influences, and disturbances on the land or marine area, and participating in the socio-economic institutions that can influence those uses. It involves building support and collaboration from all actors – landholders, resource rights holders, government agencies at all levels, concerned or interested organizations, businesses, conservation investors, and all other interested parties or stakeholders. Information must be presented in a way that is credible, objective, and based on best available science. It must include practical educational aids and on-going dialogue and knowledge exchange about the critical human-nature interdependencies, growing threats from development and other factors such as climate change, what connectivity actions are needed on the ground, and how they can be implemented in a collaborative way with the resources and capacities available. The goal of this awareness-building and collaboration should be to collectively define an overall connectivity vision and, as needed, specific connectivity conservation goals and actions to restore or protect identified priority areas. 73

Promoting stewardship. An overarching goal that needs to be part of the management strategy is to promote basic conservation values and a stewardship ethic for people to practice in their everyday lives as an integral part of their life style. Effective stewardship helps to maintain and restore the functions of natural resources, air, land, water, and biodiversity that humans rely on to produce the ecological goods and services they need for life. With stewardship comes political support, funding and other resources, partnerships, volunteer initiatives, creative and new technological inventions, and workable tools for implementation. The Land Stewardship Centre of Canada emphasizes the importance of making stewardship a priority and has set out four guiding principles of environmental sustainability to guide stewardship as summarized in Box I (1)-2, below. 74

Box I(1)-2: Guiding principles of environmental sustainability to guide stewardship

Caring for the system as a whole – Adopting an ecosystems, holistic resource management approach includes understanding the fundamental roles and values of natural systems, building up biological fertility in the soil, incorporating an understanding of the ecological cycles on the landscape (water, energy, nutrients) and how land-use practices can either benefit, be in harmony with or negatively impact these cycles and other land-users, flora and fauna.

Conserving resources – Maximizing efficiency and striving to reduce the consumption of renewable and non-renewable resources; long-term optimization versus short-term maximization of production.

Maintaining and enhancing stability in nature – Sustaining and encouraging natural biological diversity and complexity; maintaining natural areas and functions of the land (i.e. wildlife habitat conservation).

Applying cultural values – Caring for the health of the land for future generations and long-term economic stability; the link between civilization (urbanization) and the land-base and ecosystems that are vital to survival; the intrinsic value and right to exist of all life on Earth.

Source: Land Stewardship Centre of Canada website at www.landstewardship.org/.

Managing entire landscapes/seascapes. According to studies, the most common landscape-level design strategy is to use linkages, including corridors, with positive effects, particularly for dispersal and diversity. A recent study undertaken by scientists at Utah State University (USA) reviewed 78 experiments from 36 other studies between 1988 and 2008, and found that corridors increase movement between habitat patches by approximately 50% compared to patches that are not connected with corridors (Gilbert-Norton et al., 2010). That study also found that corridors were more important for the movement of invertebrates, nonavian vertebrates, and plants than they were for birds. New studies continue to assess and confirm the value of connectivity areas. 75

76 Other key lessons have emerged from landscape ecology and conservation biology for managing landscapes/seascapes for connectivity (Taylor et al., in Crooks and Sanjayan, 2006, p. 36-37). Because landscape/seascape connectivity is species-specific and organisms will exhibit a diversity of responses to any given management intervention, managers must attempt to manage for a range of responses, across a range of organisms and a range of spatial scales. This approach requires preserving natural connectivity functions where there needs to be high connectivity and restoring connectivity where it is needed but currently hampered by habitat fragmentation or loss. Three main considerations are involved:1) species movement patterns and behavior, 2) the size and arrangement of resource patches, and 3) the matrix (Taylor et al., in Crooks and Sanjayan, 2006, p. 36-37).

77 Studies have found that the 'matrix' is an integral part of landscapes/seascapes and should be considered together with patches and linkages such as corridors in the design of connectivity measures. This is particularly important to increase dispersal of species. The effectiveness of connectivity conservation areas for species movement is affected by the surrounding 'matrix' landscape (Baum et al., 2004). The connectivity conservation areas need to be part of decision-making concerning resource use and development in the matrix. To protect connectivity patches, for example, it may be important to remove or move roadways, restrict urban development, prohibit industrial development and restrict use of certain chemicals such as pesticides and fertilizers. These decisions involve broader policy and economic choices in many cases and require political will supported by the stakeholders and affected interested groups. In some situations, stakeholder voices may be powerful enough to prevent implementation. Thus, meaningful consultation and information access are critical so that affected interests understand the scientific basis for managing the matrix in certain ways and the broader benefits of such actions (Crooks and Sanjayan 2006, p. 37).

78 **Using an ecosystem approach.** Management considerations for connectivity conservation areas should be defined in the context of a science-based ecosystem approach, a concept defined and recognized, in particular, with respect to biodiversity conservation (see Box I(1)-1 above). Using an ecosystem-based approach is an important concept to take into account in legal frameworks for protected areas with respect to both establishment and management (Lausche, 2011). It also provides a scientific framework for defining connectivity conservation needs, connectivity conservation areas, and specific connectivity goals for particular areas in order to adequately protect species, species habitats, species movements and ecological processes. Based on these definitions, planners and managers are able to identify tenure arrangements in important connectivity areas and, where the lands are private or communal, different voluntary initiatives by landholders that are important to help with the connectivity outcomes.

79 Protected areas commonly are impacted by and dependent upon the ecological processes of the larger ecosystems of which they are a part, whether these systems are defined on a small scale (such as a wetland, forest, or coral reef) or on a large scale (such as boundaries along ranges of particular species, hydrological flows, mountain ranges, , or other ecological attributes). Within those larger ecosystems, lands and resources outside the boundaries of designated protected areas may have intensive uses (such as agriculture, settlements, manufacturing, mining), and many of these uses may have potentially negative effects on the protected area directly or in surrounding areas that impact the area (Hansen and DeFries, 2007; DeFries et al., 2007). An ecosystem approach to planning and managing protected areas as part of a system or network will help identify connecting needs in the context of these threats. The ecosystem approach also helps identify what production or settlement regimes may able to exist in such connectivity conservation areas, or modifications that may be important to explore with landholders or businesses. Along with other planning tools, the approach also is able to take into

account major environmental changes, including climate change, and adaptive considerations that may be needed to respond to current and anticipated impacts from such changes.

Designing specific connectivity conservation measures. A variety of landscape ecology tools are available for designing specific linkages within a broader landscape or seascape (the matrix) for connectivity conservation. As discussed above, these include adding buffers around established protected areas and reinforcing existing and adding new wildlife corridors and passageways. Other management techniques may focus on designating greenbelts with native vegetation or forests, protecting and expanding hedgerows, modifying grazing and harvesting regimes, identifying key stepping stones or habitat patches needed for specific biodiversity or ecosystem functions, and restoring sites within landscapes or seascapes that may be important for specific connectivity purposes. Planning and implementing landscape ecology tools for connectivity conservation also must take into account the dynamics of climate change impacts, including species range shifts and whole biome shifts. The bio-physical environment is not static and this adds to the complexity of planning, managing, and evaluating specific actions. 80

Increasingly there is scientific support for designing individual, local level sites in the context of large-scale connectivity conservation so that the linkages are sufficiently strong between individual protected areas and broader landscapes/seascapes to maintain ecological processes and biological communities at a national or multi-country level (Worboys et al., 2010). The visual application of basic landscape ecology concepts - patch, corridor, matrix, mosaic – is aided by use of geographic information systems and remote sensing technology for land/sea features, species habitats, and species movements on a large scale. 81

Management plans. Management plans for protected areas are commonly a requirement in protected areas legislation. Management planning also is needed for designed connectivity conservation areas to ensure that the connectivity needs of the protected area systems and areas are addressed. Therefore, the protected area management plan is a principal, initial tool for laying out the connectivity needs of the protected area or areas being addressed. This should include defining the connectivity functions that a particular connectivity conservation area, or components of the area, may need to serve in order to sustain the protected area. In addition, the protected areas management plan should indicate, to the extent feasible and using the best available scientific information, what specific habitat or ecosystem conservation or restoration measures may be needed to fulfill those functions. That analysis would provide important information about what activities may be possible or should be prohibited in the matrix area, including where certain activities should be restricted or conditioned by a special permit or other authorisation (Crooks and Sanjayan, 2006). 82

Adaptive management. Adaptive management, as discussed at length in the *IUCN Guidelines for Protected Areas Legislation*, is not a new concept to conservation. It is an important concept to incorporate in protected areas legislation and management plans, and is a central tool needed for connectivity conservation. As explained in the literature, adaptive management is not management by trial and error. As applied to protected areas and connectivity it is an approach to management that allows for an iterative process of regular review and revision of management interventions based on continued monitoring and research about how the ecosystems and species are responding and are being impacted by changing conditions. These changing conditions could include changes in surrounding land and resource uses, changes in the broader socio-economic context in which the landscape/seascape is being managed, or changes of a global nature, particularly climate change. Adaptive management is a concept particularly relevant for connectivity conservation management and should be reflected and recognized in legal instruments supporting connectivity. 83

84 **Restoration.** Where restoration is a management strategy, studies have shown that it is important to take into account how the broader landscape or seascape relates to restoration of the site, history of the site, and its historical connectivity and use. This is particularly important in order to preserve plant diversity and understand how species composition may have changed with time and site usage, for example, for agriculture or forest areas, because these sites may now differ in species composition from their more natural historical state (Brudvig and Damschen, 2011). Looking forward, the design of restoration measures also must take into account the dynamics of climate change, both near-term and long-term.

85 **Monitoring.** Just as the management strategy for connectivity conservation must extend to the landscape/seascape scale to address needs of a protected area system or network overall, the scope of monitoring must be similarly extended. Monitoring regimes should not only address the effectiveness of local level management actions, but also should take into account impacts, influences, and changes operating at a larger ecosystem or biome scale that may have a bearing on effectiveness. Without monitoring on a comparative spatial scale to that being used for management planning and action, it is not possible to design suitable conservation measures for issues arising at the specific site.

86 Recognizing the importance of large and small-scale interactions, conservation biologists have proposed monitoring and assessing biodiversity using four overlapping levels: regional landscape, community-ecosystem, population-species, and genetic (Noss, 1990). Appropriate monitoring indicators should be identified for each level, from relatively coarse indicators at the regional level to specific indicators for measuring genetic variation and genetic stress. The aim is to inventory, monitor, and assess important biodiversity elements more holistically over time, rather than in the traditional species-by-species approach. The broader perspective to monitoring helps: identify important linkages and impacts across spatial scales (including impacts from climate change), define actions to most effectively address the priority high-risk biodiversity areas, and provide a framework for coordination between agencies and groups that may need to be involved in defining and implementing those actions.

87 With respect to specific elements to monitor for connectivity conservation, one study proposes six main aspects that may have different reporting requirements depending on the scale involved, as illustrated in the management framework example in Figure I(1)-3 above. These six aspects are: 1) land-cover, land-use, and landscape patterns (for example, fragmentation, patch size, connectivity); 2) human population density through monitoring the number of settlements and households; 3) infrastructure/access (for example, construction of roads, conversion of road from unpaved to paved, creation of new logging roads, canals, and dam construction); 4) active fire and burned areas; 5) direct human impacts, such as timber harvesting, grazing by domestic animals, and hunting; and 6) surface water and rain quality (for example, sediment load. pH, nutrient concentrations, pollutants (DeFries et al., 2007, p. 157). Current and projected climate change may have impacts on any of these aspects and also need to be part of the monitoring focus.

88 **Evaluation.** To understand effectiveness, evaluation of connectivity conservation actions is critical both to assess whether the management plan is achieving the stated objectives and also to defend the investment to policy makers, supporters, communities, and the public at large. Evaluation must be a long-term commitment. It is important that performance indicators are identified and that these indicators are able to be measured through information collected during the monitoring process. The performance indicators must be tailored to the needs of the different scales. In broad terms, the evaluation process has two components: 1) the planning process and the resulting management plan and strategy from that process and 2) the results of implementing the plan and the outcomes achieved as measured against the plan's objectives (Worboys and Lockwood, 2010, Ch. 1).

Working with policy and law. Scientists, conservation advisors, protected areas managers, and other leaders in connectivity conservation need to have a working knowledge of existing law and policy tools that do or could support connectivity conservation initiatives and are in a good position to take a catalytic role in advising on, collaborating, and cooperating with others to apply and strengthen those tools as needed. Other government institutions across sectors and levels of government, communities, groups, businesses, and organizations such as NGOs or international entities may manage complimentary programs and have separate legal authority, technical capacity or financial resources that also could support general or specific connectivity conservation goals and actions. With large-scale connectivity conservation areas, treaties, agreements, or administrative arrangements with adjoining countries or jurisdictions also may be in effect with obligations or commitments that could be used to support connectivity conservation. 89

2 Benefits of connectivity conservation

Introduction

Building on the connectivity science and management concepts laid out in section I, this section highlights key benefits coming from well-designed connectivity conservation areas and management plans. In the broadest sense, connectivity conservation is a valuable tool across landscapes/seascapes as well as for small-scale local areas to help conserve species and maintain ecological processes and ecosystem services for the well-being of human communities. Scientists, planners, and resource managers are increasingly identifying important benefits from connectivity not only for maintaining and restoring ecosystems and biodiversity. They see a critical role also in relation to climate change adaptation and, for some carbon-rich ecosystems (such as forests, grasslands, peatlands, wetlands, coastal mangroves, and seagrass beds), in relation to climate change mitigation where connectivity conservation measures can protect and enhance the role of such ecosystems in carbon storage and sequestration. 90

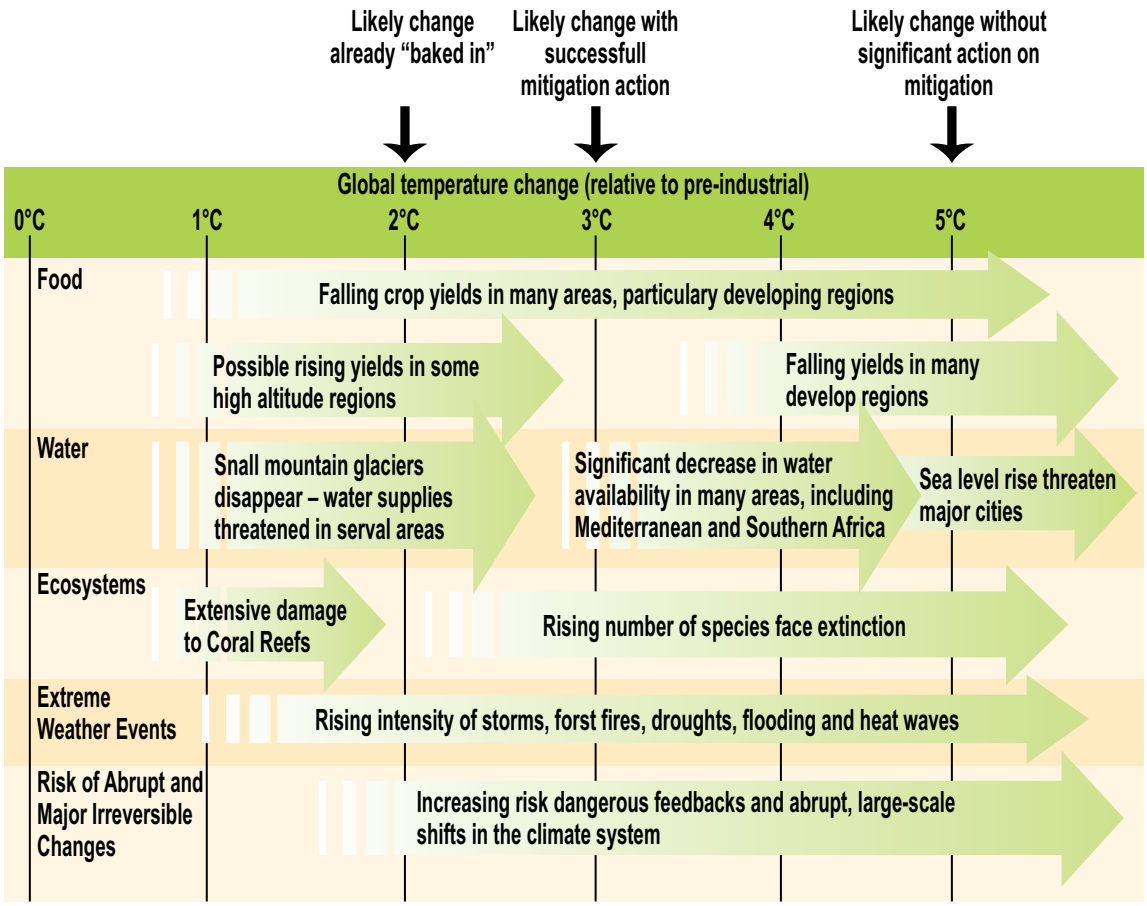
This section discusses benefits that flow from connectivity conservation in four main themes: benefits for biodiversity conservation, benefits for climate change adaptation, benefits for climate change and mitigation, and co-benefits for both biodiversity and climate change strategies. The discussion of co-benefits gives special attention to the significant potential of international initiatives such as the UNFCCC programme called REDD (**R**educing **E**missions from **D**eforestation and forest **D**egradation) and REDD+. 91

For context, it is worth briefly reviewing the relationship between climate change and biodiversity. As discussed in Part I(1)-4 above, there is growing scientific consensus that climate change is and will continue to have serious impacts on the earth's natural systems. Figure II(2)-1 illustrates the relationship between climate change on Earth systems under varying degrees of global temperature increase. 92

Climate change threatens biodiversity both directly and indirectly. As global temperatures rise, climate change has a direct impact on the distribution and survival of species, species communities, and ecosystems, and their ability to function. Climate change also threatens biodiversity indirectly over the near- and long-term through a cascade of many impacts from climate change and global temperature rise such as extreme weather events, drought, floods, wild fires, extreme heat, sea level rise, and ocean acidification. One or more of these impacts are already being experienced in countries around the world, in many cases with severe socio-economic impacts on human communities. 93

94 The linkages between climate change and biodiversity has become the subject of scientific studies. The theme is also an emerging area of convergence for the United Nations Framework Convention on Climate Change (UNFCCC) and the United Nations Convention on Biological Diversity (CBD). The Ad-hoc Technical Expert Group on Biodiversity and Climate Change under the CBD concluded in 2009 that some species are already being negatively affected from direct and indirect climate change impacts. Particularly vulnerable are aquatic freshwater habitats, wetlands, mangroves, coral reefs, arctic and alpine ecosystems and cloud forests. Montane species and endemic species have been identified as exceptionally vulnerable due to narrow geographic and climatic ranges and limited dispersal opportunities, among others (CBD, 2009).

Figure I(2)-1: Global temperature rise and projected impacts from climate change



Source: Adapted from IPCC 2007.

95 Wild plant and animal species, species populations and species communities impacted by climate change will react in different ways depending on the site and their inherent abilities to adapt (Worboys, 2008). Some will be able to deal on site with hotter, potentially drier or wetter conditions, extreme weather events, sea level rise or other impacts depending on their ability to cope. Others may undergo genetic changes and with time adapt in an evolutionary sense in order to cope with the changing environmental conditions. Many species will be forced to move and adapt to new areas so long as movement is feasible and suitable habitats exist. Some may survive in specially protected refuge areas, and others may simply die out. According to the IPCC, for every 1 degree Celsius rise in global mean temperature, it is estimated that 10% of species assessed so far are predicted to be at an increasingly high risk of extinction (IPCC, 2007).

In recent decades, scientific understanding about the potential of connectivity conservation to help reverse accelerating rates of biodiversity law has advanced considerably (see Part I, section 1.1 above). Climate change has become the new element that nature conservation and connectivity planning must take into account. As discussed in Part I, the extent that climate change will impact biodiversity, ecological networks and ecosystem processes will depend on how much and how fast the climate continues to change. However, even with uncertainties about the degree and rates of change, scientists and conservation practitioners increasingly are recognizing that science-based connectivity conservation (through such concepts as ecological networks, corridors, and buffer zones) is an important tool, as part of a suite of approaches, to benefit biodiversity conservation, climate change adaptation and climate change mitigation (Bennett and Mulongoy, 2006). 96

Finally, it is important to keep in mind that benefits of connectivity conservation ultimately must be defined in terms of benefits to human communities. As ecosystems and ecosystem services are adversely, if not irreversibly, affected with climate change, there are serious social and economic consequences (CBD, 2009). The resilience of human communities and their socio-economic systems is dependent upon the resilience of terrestrial, aquatic and marine ecosystems on which they rely for their livelihoods and life support systems. As emphasized by a recent World Bank study, protecting forests and other natural ecosystems provide social, economic, and environmental benefits both directly through more sustainable management of biological resources and indirectly through protection of ecosystem services (World Bank, 2008). 97

2.1 Benefits of connectivity for biodiversity

The most significant impact humans have had and continue to have on biodiversity are the changes being made in natural connectivity through development of lands and resources that ultimately cause fragmentation and degradation (see section 1). Using connectivity conservation to connect and reconnect natural habitats and create ecological networks has become a recognized strategy for protecting biodiversity (see discussion of ecological networks in Europe in Part II, section 2.2, above). 98

The science of connectivity conservation came about because habitat fragmentation and land degradation from development were threatening the survival of wild species and essential ecological processes important for human well-being and livelihoods (see background discussion in section I). Historically, research on connectivity conservation focused mainly on benefits for biodiversity and ecosystems. In light of global trends toward increased ecosystem degradation and habitat loss, such benefits continue to represent connectivity conservation's most compelling case. 99

Recent studies confirm that efforts spent on maintaining and creating linkages for connectivity as part of protected areas networks are worthwhile for biodiversity and ecosystem maintenance (Gilbert-Norton et al., 2010). In addition to an increase in connectivity, corridors and other natural linkages may maintain or increase habitat area to facilitate species movement which may be critical in helping sustain species populations and diversity of species with relationships to that area. 100

Studies also have found that corridors and other natural linkages which already exist in the landscape show more species movement than manipulated experiments (Haddad et al., 2011). Such findings reaffirm the principle that it is better (where feasible) to protect natural landscape features important for connectivity functions than to try to create new linkages. It appears that the majority of mobile species respond positively to corridors and other linkages even though use is at different rates and degrees. As discussed more below, this also suggests the importance of connectivity as a climate change adaptive strategy for many organisms (Gilbert-Norton et al., 2010; Haddad et al., 2011). 101

102 Connectivity conservation provides an array of benefits important to nature and people. On a large spatial scale, connectivity areas facilitate the migrations of animals between breeding and wintering areas, or over daily, seasonal, and annual time-frames, even if no protected areas are specifically established for their habitat (Marra et al., in Crooks and Sanjayan, 2006, ch. 7). Hydrologic connectivity transfers matter, energy and organisms through the medium of water within or between elements of the hydrologic cycle. These functions are critical for maintaining the biological integrity of ecosystems and providing water and other ecosystem services for peoples see environmental flows in Part II, section 3.1.9, below).

103 On a smaller scale, connectivity conservation provides important biodiversity benefits for local areas. Hedgerows, forest belts around agricultural fields, and patches of natural vegetation interspersed in semi-developed areas are examples of connectivity conservation measures which provide habitat for locally important species (birds, butterflies, amphibians) and local ecosystem services. For example, the dominant crop pollinators worldwide are bees, which rely on natural connectivity among different habitat types particularly floral habitats (Ricketts et al., in Crooks and Sanjayan, 2006, ch. 11). Whether on a small or large scale, connectivity conservation areas may also provide recreational, tourism, educational, spiritual, and scientific benefits so long as consistent with the primary conservation purpose, and by doing in some cases may generate monies through fees and services to invest back into the area.

2.2 Benefits of connectivity for climate change adaptation

104 Recent studies acknowledge that connectivity conservation can be expected to be a global response to climate change (Aune et al., 2011). Protected areas already are facing significant and growing development pressures from outside their boundaries and climate change will exacerbate these threats. This will be even more the case in areas outside protected areas (matrix areas) where habitats and ecosystem functions support the protected areas. Indeed, the bulk of the Earth's surface is not in protected areas. This means that the future of the vast majority of the Earth's biodiversity and its ability to adapt to climate change depends on how matrix areas are managed (Franklin and Lindenmayer, 2009). As climate change and development pressures grow, the degree to which remaining natural and semi-natural areas outside formal protected areas are functionally linked becomes increasingly critical (Aune et al., 2011). Well-designed connectivity conservation areas and management regimes offer important adaptation benefits for biodiversity by improving resilience of ecosystems and facilitating natural movement of species.

105 Connectivity conservation benefits biodiversity and ecosystems by facilitating climate change adaptation in several ways. First, well-designed connectivity conservation areas assist plant and animal species, populations, and communities to extend their geographic range to more suitable climatic conditions. While range expansion is dependent on complex ecological relationships, it is likely that the protection and establishment of vast tracts of continuous natural habitat can create options for the migration of groups of co-adapted plants and animals. For some groups of animals, migration between habitats at higher and lower elevations is common and elevation linkages help facilitate range shifts more than linkages across uniform elevations (Bennett, 2003).

106 Second, in the face of climate change impacts, connectivity conservation can facilitate the continuity of specific species populations throughout their geographic range by creating adaptive corridors and networks that maximize the populations' ability to survive within the range so long as they can cope with the climatic conditions within the range. Corridors, for instance, can provide escape routes and other opportunities for animal populations to move away from threatened habitats (Anderson and

Jenkins, 2006). These linkages also can act as alternative refuges from large disturbed areas impacted by such climate change impacts as fire or extreme weather events (Crooks and Sanjayan, 2006, p.10). Scientific research also suggests that redistribution of animal populations within an existing range is more feasible and more likely to succeed than shifts through relocation to completely new areas (Bennett, 2003).

Third, connectivity conservation facilitates climate change adaptation by linking protected areas and reserves in ways that can build and maximize resilience of present protected area networks and systems, their associated ecosystems and ecosystem services. Ultimately, such linkages advance the biodiversity goals of protected area systems and networks, and sustain and enhance productive capacity of the associated biodiversity and ecosystems. 107

Scientific studies also are finding that connectivity conservation in large contiguous habitats with greater demographic and genetic capacity to respond to changing conditions are likely to be most effective in providing options for near-term and gradual adaptation to climate change (Bennett 2003). For instance, there may be concerns that potential migration and adaptation rates of certain tree species may not be able to keep pace with projected rates of global warming (Davis, 1989; Huntley, 1991; Dyer, 1995; Collingham et al., 1996; Malcolm et al., 2002). Fragmentation has the potential to adversely affect the genetic and reproductive capacity of such populations to adapt. Connectivity conservation measures that help to link ecological processes and services into networks may provide the most favourable ecological circumstances for seed dispersal or genetic adaptation change for biodiversity and species resilience over time (Thompson et al., 2009). 108

Finally, it is important to recall the essential relationship between climate change adaptation of natural systems and the well-being of human communities. The underlying theme of the 2005 U.N. Millennium Ecosystem Assessment is the inextricable linkage between human well-being, biodiversity and ecosystems and the development challenges ahead as climate change adversely impacts biodiversity, ecosystems, and the associated goods and services they provide. 109

Biodiversity, natural ecosystems and ecosystem services underpin economic development. Resilient natural systems help reduce vulnerabilities and disaster risk to help human communities adapt to climate change. Biodiversity and ecosystems contribute to material welfare and livelihoods, security, social relations, health, and resilience in the face of global change, including climate change. Connectivity conservation has an essential role to play in helping biodiversity and ecosystems adapt to climate change in order to sustain these important contributions to human needs. Human communities must be stewards and partners in conservation to support climate change adaptation of natural systems through connectivity conservation and other means in order to build and sustain the resilience of human social and economic systems to climate change over the near- and long-term. 110

2.3 Benefits of connectivity for climate change mitigation

Recent studies have demonstrated that a large part of the carbon being released into the atmosphere (17 per cent of total global greenhouse gas emissions) is coming from stored carbon in land and vegetation (IPCC, 2007). In particular, these emissions are the result of land disturbances such as deforestation, forest degradation, land-use change, and soil disturbances. 111

According to a recent CBD technical report, approximately 2,500 gigatons of carbon (GtC) are stored in terrestrial ecosystems, while an estimated 38,000 GtC are stored in oceans and 750 GtC in the atmosphere (CBD, 2009). Therefore, small changes in terrestrial and ocean systems to store carbon 112

(in scientific terms, acting as a carbon sink) or to release carbon (thereby acting as a source of carbon emissions, or carbon source) have major implications for atmospheric carbon dioxide levels and climate warming.

113 Biodiversity affects carbon storage in that it facilitates how much carbon is taken out of the atmosphere by species and ecosystems and how much is released into it. Many ecosystems, particularly forests in land and coastal areas (mangroves, sea grass beds, kelp forests), are acting as significant carbon sinks, capturing (carbon sequestration) and storing carbon at the equivalent of an average of 30 per cent of the carbon emissions produced or caused by humans annually. The sustainability and healthy functioning of these forests and other ecosystems are and will increasingly be threatened by climate change in direct and indirect ways. Without management techniques that help forests and carbon-based ecosystems adapt to climate change, these natural systems may be massively transformed from carbon sinks into carbon sources as they degrade or are destroyed, not only causing the release of stored carbon that they have stored, but also foregoing the ability of these systems to sequester additional carbon in the future (CBD, 2009; CBD, 2011b).

114 Connectivity conservation benefits climate change mitigation by increasing the stability of natural landscapes for the complementary purpose of carbon storage, as well as for enhancing existing carbon stocks through, among other things, reforestation and restoration efforts. Connectivity conservation provides the scientific and management platform for preventing carbon emissions from deforestation and ecosystem degradation. This requires retaining or extending natural areas important for biodiversity and critical ecosystem services, instead of losing these areas for clearing and conversion to other land-uses.

115 Importantly, the added value of connectivity conservation for climate change mitigation lies in its potential to establish links between carbon sinks within and outside protected areas. Table I(2)-1 illustrates the distribution of the world's terrestrial carbon stocks overall and in protected areas. If Greenland is excluded, only from 0.3 to 27 per cent of the world's terrestrial carbon stocks are officially in protected areas. This means that connectivity conservation has significant potential for enhancing carbon-based climate change mitigation outside protected areas where the components of biodiversity being protected also can play a role in carbon sequestration.

Table I(2)-1: Estimated worldwide carbon storage by region in gigatons (Gt)

Region number	Region	Terrestrial carbon stock, Gt		Carbon in protected areas %
		Total	In protected areas	
1	North America	338	59	15.1
2	Greenland	5	2	51.2
3	Central America & Caribean	16	4	25.2
4	South American	341	91	26.8
5	Europe	100	14	13.6
6	North Eurasia	404	36	8.8
7	Africa	356	49	13.7
8	Middle East	44	3	7.8
9	South Asia	54	4	7.2

10	East Asia	124	20	16.3
11	South East Asia	132	20	15.0
12	Australia/New Zeeland	85	10	12.0
13	Pacific	3	0.1	4.3
14	Antarctic & peripheral islands	1	<0.1	0.3
(Percentages calculated from carbon figures in tonnes, rather than the gigatons presented here). Source: Campbell et al., 2008.				

2.4 Connectivity co-benefits for biodiversity and climate change

Connectivity conservation, for reasons already stated above, can deliver benefits to climate change strategies in two respects. It functions to help restore and maintain biodiversity in the face of climate change by providing space and ecosystem resilience for adaptation. Connectivity conservation can facilitate climate change mitigation when the management practices suitable for connectivity also are able to maintain and, in many cases, enhance the capacity of land and sea areas to capture and store carbon (World Bank, 2008). 116

Co-benefits hinge on international, regional and national policies and programmes that recognize connectivity linkages and harmonize biodiversity and climate change strategies and activities for mutually beneficial actions. In other words, linkages among biodiversity components can be designed to protect biodiversity and, where appropriate, also maintain and expand the world's natural systems capable of serving as carbon sinks. For this goal to be fully realized, countries and international organisations must extend the scope of their conservation and development planning, incentive programmes, and related legal mechanisms to recognize and promote linkages for biodiversity and ecosystems that also provide benefits for climate change adaptation and, as appropriate, mitigation. 117

International initiatives are already underway to encourage countries to reduce emissions from deforestation and forest degradation while promoting biodiversity conservation. A major initiative gaining global attention and support for its potential co-benefits is the UNFCCC mechanism called REDD (an acronym for Reduction of Emissions from Deforestation and forest Degradation), created by the Parties to the UNFCCC in 2005 and expanded to REDD+ in 2010. As introduced below in Part II, section 1 on international law, REDD+ is an incentive mechanism to stimulate action, particularly in developing countries, to prevent release of carbon emissions by reducing and preventing deforestation and forest degradation while promoting biodiversity conservation. In adopting REDD+, the UNFCCC Conference of the Parties affirmed that implementation of REDD+ activities should include the promotion and support of several safeguards including: 118

> That actions are consistent with the conservation of natural forests and biological diversity, ensuring that the actions are not used for the conversion of natural forests, but are instead used to incentivize the protection and conservation of natural forests and their ecosystem services, and to enhance other social and environmental benefits (Decision 1/CP.16, Appendix 1, para. 2).

That decision also included the safeguard that actions under REDD+ complement or are consistent with relevant international conventions and agreements, including the CBD. By many accounts, REDD+ has become an area of convergence between the UNFCCC and the CBD, with the CBD being invited to make submissions on relevant biodiversity safeguards for REDD+ (see, for example, UNFCCC, 2011; CBD COP 2012 VI/19; CBD, 2011a; CBD, 2011b; Larsen et al., 2012; Epple et al., 2011). (See discussion in Part II, section 1, below.) 119

120 While the focus of the original REDD was on reducing emissions from deforestation and forest degradation, the mechanism was significantly expanded to acknowledge the importance of nature-based solutions to climate change. Today, activities that may qualify for REDD+ support include sustainable forest management, conservation of forests, and enhancement of natural areas important as carbon sinks. The movement from REDD to REDD+ reflected a changing perspective and more conservation-oriented purpose for the mechanism itself. REDD+ does not just view natural forests as carbon stock, but far more importantly, it views natural forests as part of natural systems that support biodiversity and provide ecosystem services which in turn help to keep landscapes and seascapes stable in retaining and enhancing their carbon storage. REDD+ provides the opportunity for incentives to take action, including connectivity conservation, that aid with climate change mitigation while also playing a significant role in conserving biodiversity and ecosystems. Table I(2)-2 lists five categories of activities for REDD+ support.

121 As for the current status of REDD+, it is a work in progress. Its creation reflects a clear commitment by governments worldwide to support efforts to avoid deforestation and forest degradation as a cost-effective way of addressing climate change mitigation (Eliasch 2008). REDD+ activities are expected to be undertaken in three main phases (see Table I(2)-3).

Table I(2)-2: Categories of activities for support under REDD+

		Activity	Example
Reducing carbon emissions	1.	Reducing deforestation	Slowing the rate of broad scale or clear fell logging
	2.	Reducing forest degradation	Reducing forest areas affected by selective logging, grazing, fire or fuel wood collection
Increasing the removal of carbon (the 'plus')	3.	Conserving forest carbon stocks	Preservation of existings forests
	4.	Sustainable management of forest	Extending logging cycles from 10 years to 30 years to allow a greater amount of carbon to develop in regrowth
	5.	Enhancement of forest carbon stocks	Forest regeneration and rehabilitation (but not afforestation and reafforestation)
Source: Wertz-Kanounnikoff and Angelsen 2009			

122 REDD+ faces a particular challenge to mobilize the finances needed for developing countries participation. Recognizing this challenge, the decision of the Parties at the 16th COP to adopt REDD+ included a request to the Ad Hoc Working Group on Long-term Cooperative Action under the Convention to explore financing options for developing countries to undertake demonstration activities and results-based actions that contribute to migration actions through the five areas of REDD+ activity (UNFCCC COP 2010 XVI/1, para. 77). Pursuant to that committee's recommendations, the 17th COP established the Green Climate Fund and prescribed a set of detailed provisions for its operation (UNFCCC COP 2011 XVII/2/Annex). Among the actions eligible for the Fund are REDD+ activities, expressed in the decision as follows:

> All developing country Parties to the Convention are eligible to receive resources from the Fund. The Fund will finance agreed full and agreed incremental costs for activities to enable and support enhanced action on adaptation, mitigation (including REDD+),technology development and transfer (including carbon capture and storage), capacity-building and the preparation of national reports by developing countries (UNFCCC COP 2011 XVII/2/Annex, para. II.B).

The 17th COP also adopted an associated decision Parties to make financial contributions for the start-up of the fund, including for administrative costs (UNFCCC COP 2011 XVII/3). 123

There are several other issues needing attention for REDD+ implementation. These include such matters as providing guidance on the information systems to be used to address safeguards and on methods for reporting financial information. An example of a substantive area needing attention for REDD+ implementation relates to providing guidance and safeguards for the policy approaches and positive incentives that will apply for developing countries to receive REDD+ support. At the 16th COP, as part of its decision to create REDD+, Parties requested the UNFCCC Subsidiary Body for Scientific and Technological Advice (SBSTA) to develop a work programme for such guidance and safeguards related to reducing emissions from deforestation and forest degradation and the role of conservation, sustainable management of forests and enhancement of forest carbon stocks in developing countries (UNFCCC COP XVI/1, para 75). SBSTA continues its work toward this end taking into account the views of Parties and accredited observers and convening meetings of technical experts. 124

Table I(2)-3: Elements of a phased approach for REDD+

	Phase 1	Phase 2	Phase 3
Scope	RED/REDD/REDD+	REDD/REDD+	REDD+
Crediting scale	Subnational	Nested (both national and subnational)	Nested or national approach
Performance indicators	Strategy adopted Legislative and policy assessment completed Consultations conducted Institutions in place	Policies enacted Measures enforced Proxies for forest carbon changes	Quantified forest carbon changes (tCO_2e), compared to a reference level
Funding	Initial support for national strategy development and readiness activities (e.g. FCPF, UN-REDD, bilateral initiatives)		Primarily linked to compliance carbon markets, but might also be via global fund
MRV systems	Capacity development	Capacity development and basic monitoring capacities	Advanced monitoring capacities and setting reference levels
Source: Meridien Institute, 2009			

As set forth in Table I(2)-4 below, there are many ecosystem-based adaptation efforts that could be supported by REDD+ to provide co-benefits for both biodiversity and climate change. 125

Table I(2)-4: Adaptation measures for REDD+ support and co-benefits

		Additional benefits			
Adaption measure	Adaptive function	Social and cultural	Economic	Biodiversity	Mitigation
Mangrove conservation	▸ Protection against storm surges, sea-level rise and coastal Inundation	▸ Provision of employment options (fisheries and prawn cultivation) ▸ Contribution to food security	▸ Generation of income to local communities trough marketeing of mangrove products (fish, dyes, medicines	▸ Conservation of species that live or breed in mangroves	▸ Conservation of carbon stocks, both above and below-ground
Forest conservation and sustainable forest management	▸ Maintenance of nutrient and water flow ▸ Prevention of land slides	Opportunities for ▸ Recreation ▸ Culture ▸ Protection of indigenous peoples and local communities	Potential generation of income through: ▸ Ecotourism, ▸ Recreation ▸ Sustainable logging	▸ Conservation of habitat for forest plant and animal species	▸ Conservation of carbon stocks ▸ Reduction of emissions from deforestation degradation
Restoration of degraded wetlands	▸ Maintenance of nutrient and water flow, quality, storage and capacity ▸ Protection against floods or storm inundation	Sustained provision of: ▸ Livelihood ▸ Recreation ▸ Employment opportunities	Increased: ▸ Livelihood generation ▸ Potential revenue from recreational activities ▸ Sustainable use ▸ Sustainable logging of planted trees	▸ Conservation of wetland flora and fauna through maintenance of breeding grounds and stop over sites for migratory species	▸ Reduced emissions from soil carbon mineralization
Establishment of diverse agroforestry systems in agricultural land	▸ Diversification of agricultural production to cope with changed climatic conditions	▸ Contribution to food and fuel wood security	▸ Generation of income from sale of timber, firewood and other products	▸ Conservation of biodiversity in agricultural landscape	▸ Carbon storage in both above and below ground biomass and soils
Conservation of agrobiodiversity	▸ Provision of specific gene pools for crop and livestock adaptation to climatic variability	▸ Enhanced food security ▸ Diversification of food products ▸ Conservation of local and traditional knowledge and practices	▸ Possibility of agricultural income in difficult environments ▸ Environmental services such as bees for pollination of cultivated crops	▸ Conservation of genetic diversity of crop varieties and livestock breeds	
Conservation of medicinal plants used by local and indigenous communities	▸ Local medicines available for health problems resulting from climate change or habitat degradation, (e.g., malaria, diarrhea, cardiovascular problems).	▸ Local communities have an independent and sustainable source of medicines ▸ Maintenance of local knowledge and traditions	▸ Potential sources of income for local people	▸ Enhanced medicinal plant conservation ▸ Local and traditional knowledge recognized and protected.	▸ Environmental services such as bees for pollination of cultivated crops
Sustainable management of grassland	▸ Protection against flood ▸ Storage of nutrients ▸ Maintenance of soil structure	▸ Recreation and tourism	▸ Generate income for local communities through products from grass (e.g., broom)	▸ Forage for grazing animals ▸ Provide diverse habitats for animals that are predators and prey	▸ Maintenance of soil carbon storage of soil carbon

Source: CBD and GIZ, 2011

Key messages

Science-based, well-managed connectivity conservation can be a strategy for biodiversity conservation and ecosystem protection that also contributes to building the integrity of emission reduction mechanisms such as REDD+. REDD+ provides a robust platform for ensuring that supported projects also deliver co-benefits in biodiversity and critical ecosystem services. 126

REDD+ can serve as a design and management vehicle for ensuring biodiversity and community co-benefits are delivered by properly orienting where protection and reforestation or restoration efforts are positioned. This can maximize connectivity of natural habitats and in the process assist animal, plant and human populations adapt to climate change impacts. 127

The need for periodic measurement, reporting and verification (MRV) of REDD+ activities also presents an opportunity to use connectivity conservation to establish practical criteria and indicators for monitoring and evaluating connectivity in REDD+ activities and programmes already being developed and implemented across the developing world. 128

REDD+ is an opportune entry point for establishing as well as financing connectivity outside protected areas, with private sector financing fast becoming a major contributor for REDD+ alongside public funds from multilateral, bilateral and domestic sources. Indeed, at this critical juncture in global discussions and efforts on climate change and biodiversity, connectivity conservation presents an exciting and strategic platform for ongoing and future adaptation and mitigation initiatives, while at the same time offering a powerful approach to the growing suite of tools being developed for climate change and biodiversity. 129

Connectivity conservation has the potential, in general, to help advance protected areas and associated biodiversity goals. Well-designed connectivity conservation areas help restore and maintain biodiversity and protected area systems and networks by providing space and ecosystem resilience for adaptation to current and new threats, as well as ongoing global change factors, including climate change. Such areas assist plant and animal species, populations, and communities by providing corridors and ecological networks that maximize their ability to adapt. Connectivity conservation also facilitates climate change adaptation by linking protected areas and reserves in ways that can build and maximize resilience of present protected area networks and systems, their associated ecosystems and ecosystem services. 130

3 Governance for Connectivity Conservation

Introduction

While there is no agreed international definition of governance, in general, the concept is concerned with the decision-making structures and processes used by governments and communities to implement public policy on behalf of its citizens. In the present context, it relates to decision-making processes for identifying, planning, and managing for connectivity conservation. 131

The *IUCN Guidelines for Protected Areas Legislation* describes governance as having two dimensions (Lausche, 2011, pp. 40-47, 75-92): 132

- Quality of governance – “good” governance requirements include accountability, transparency, opportunities for participation and social equity and justice. These are reflected in the three pillars

of the Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters (Aarhus Convention): reasonable access to information on the environment; public participation in decision-making and access to justice in environmental matters.

- Type of governance – who makes the decisions in relation to the creation and administration of connectivity conservation areas, and who is allowed to participate in decision-making processes.

133 This section reviews principles of good governance, particularly in the context of connectivity conservation, and then considers several factors that influence the design of connectivity conservation governance mechanisms. It explores the role that can be played by national and local authorities, non-governmental organizations, land and resource managers and the public, and the variability of resulting governance arrangements. The section focuses especially on the particular governance challenges faced where lands or resources to be managed for connectivity conservation are not owned or controlled by the state.

3.1 Applying the principles of good governance

134 Just as definitions of governance in international law and policy are varied and continue to evolve, there is no single definition of "good" governance in law and policy. As explained in the Guidelines for Protected Areas Legislation, the term is used with great flexibility and is commonly discussed in the context of good governance principles linked to human rights – civil, cultural, economic, political, social and enviromental (Lausche, 2011, p. 41). What constitutes *good* governance principles in government and societal decision making, in general, applies equally in the connectivity conservation context.

135 Major governance principles recognized by international organisations include accountability, transparency and openness, participation, the rule of law, and effectiveness. Such core principles are sometimes defined explicitly to include underlying principles, for example, meaningful participation requires access to information. The IUCN-WCPA formulation of good governance principles for protected areas identifies nine broad concepts: legitimacy and voice, subsidiarity, fairness, do no harm, direction, performance, accountability, transparency, and human rights (Dudley, 2008, in Lausche, 2011, p. 43). In the context of connectivity conservation, application of good governance principles is very much a work in progress.

136 Where a connectivity conservation area is already in government ownership, as with the classic form of protected area governance, the adequacy of governance arrangements can largely be assessed by the adequacy of provisions relating to access to information, public participation and social equity and justice (Lausche, 2010, p. 43). Where indigenous and local communities have or claim interests in land/sea areas or their resources owned or controlled by government, good governance requires a commitment by government to ensure the full participation of these communities in decision-making processes affecting those land/sea rights.

137 Once we move beyond state-owned or state-controlled land to "multi-level governance contexts in which important roles are played by both government and nongovernment institutions" (Lockwood, 2010, p. 987), new challenges emerge. Governance principles, such as transparency and participation, taken as a given where government is driving initiatives in the public domain, may become an issue where government enters into agreements and partnerships with private or community landholders on issues of widespread public interest, such as connectivity conservation.

3.1.1 Transparency and participation

Government assurance of transparency and ongoing, meaningful participation by affected and interested Parties is fundamental. In particular, where voluntary cooperation is sought in developing conservation connectivity initiatives, the importance of information flow from government to private or community landholders has been underscored in the literature (see, for example, Sandwith et al., 2010, p. 68). 138

However, the issue of *public* access to the content of specific agreements between government and non-governmental Parties needs to be handled with some sensitivity. Voluntary cooperation might be discouraged by unduly intrusive access requirements. For example, indigenous communities may have concerns about releasing agreements they have made with government to undertake certain management practices on their lands in return for specific financial or other incentives. Governments may also be justified in limiting public access to arrangements where, for example, they are negotiating the lowest possible price for certain environmental services from a private landholder through a sealed bid auction. They may reasonably want to keep the amount paid confidential to avoid collusion. At the same time, the principle of public access to information is important to the extent that the public should know the main objectives of the agreement and have access to monitoring reports in order to follow whether the objectives are being met. 139

Where matters of public interest are addressed through such tools as contractual agreements between private landholders and government or with an NGO (see section II-3.4, below), the principle of public participation in decision-making processes needs to be applied sensitively. Contracts have traditionally been regarded as private law mechanisms. The issue becomes whether a draft voluntary conservation agreement which government or an NGO enters into with a private landholder or an indigenous group should be open to public scrutiny and public comment. In a jurisdiction that gives members of civil society wide rights of access to the courts to remedy or restrain breaches of environmental law, should this extend to enforcement of voluntary agreements? The approach taken in one jurisdiction to these issues is illustrated in Box I(3)-1, below. 140

Box I(3)-1: Public participation and conservation agreements in Australia

The general position under state legislation in Australia is that there is no requirement for public comment on draft conservation agreements with private landholders. Nor do members of the public have any rights to enforce them (see *Environment Protection and Biodiversity Conservation Act* (Cth) 1999, s 309; *National Parks and Wildlife Act 1974* (NSW), s 69H; *Native Vegetation Act* 1991 (SA), s 23B; *Victorian Conservation Trust Act* 1972, s 3A(6)-(8)). The essentially private nature of agreements is confirmed by the fact that they can usually be terminated with the consent of both Parties, without any public input. However, once an agreement has been reached, it must be made publicly available, with the exception, in some jurisdictions, for material that is commercial-in-confidence.

The full and effective participation of indigenous and local communities has recently been emphasized in the context of REDD+. REDD+ carries the momentum to make forest agencies at all levels more transparent, accountable and inclusive (see Part I, section 2.4 above, and Part II, sections 1.2 and 3.5.3 below for further discussion of REDD+). To seize this opportunity, the design of REDD+ will have to include the use of procedures in decision-making and implementation that encourage public participation, democratic control over forests, and the conduct of local affairs in ways that involve the participation of indigenous and local communities (Ribot et al., 2008). While some of these procedures still need to be developed, others can be readily applied. Among them are procedures seeking free, prior and informed consent (FPIC), decentralization of forest management to elected local governments, and 141

the participation of indigenous and local communities in the management of local forests (SCBD, 2011, p. 35).

3.1.2 Social equity and justice

142 Another fundamental principle of good governance is that government should make its decisions in ways that reflect social equity and justice for those affected. In the context of connectivity conservation dealings with landholders this requires the fair and equitable sharing of costs and benefits for present generations (referred to as '*intra*generational' equity as opposed to *inter*generational equity for future generations). This is especially relevant in situations where connectivity conservation areas are identified on lands of peoples who may be under-represented or not fully aware of their rights.

143 Equity within present generations is particularly an issue where connectivity conservation proposals call for changes in how landholders or rightsholders manage their lands. Social equity and justice requires that there be a fair and equitable arrangement relating to who bears the cost of the changes.

144 In policy areas where government regulates private land use because of some overriding public interest, landholders bear the full cost (for example, preventing water pollution or soil erosion). Where the public good is not so strong, another approach is for the government to pay compensation for the effect of restrictions which it imposes on land use (which means that the public pays). This may be an appropriate route where the land use restriction required does not represent a fundamental public interest or safety or health concern. A quite different approach is for government to rely on conservation agreements negotiated with individual landholders, rather than on direct regulation. Here, government shares the cost of obligations that are voluntarily undertaken by a landholder by providing incentives and other concessions.

145 The question of what is a fair and equitable balance between public interest and private rights needs to be addressed on a case by case basis. It would be an extreme policy to concede to private landholders that they have unfettered rights to use their land as they please even where public health may be at serious risk, and argue that government can only interfere with land use in cases where a voluntary agreement can be negotiated. This would place all of the costs on the community, even unreasonable costs of actual, present-day harm and damage to that community. At the same time, landholders should be able to put their land to *some* productive use for private benefit so long as it is not harmful to the community.

146 Land is a finite commodity and there is a legitimate public interest in regulating its *future development* without having to pay compensation. This includes not only urban and industrial development but clearing native vegetation to intensify agricultural production. However, it would be quite unfair to require landholders to cease the *existing use* to which they are putting land, in order to support connectivity conservation, without at least providing compensation. At the same time, it would appear legitimate to subject existing uses to on-going assessment and modification in light of evolving best practice, providing compensation only where there is a significant reduction in productivity.

147 In addition to restrictions being imposed on land use, natural systems in areas to be managed for connectivity conservation usually require continuing, active management (Worboys and Lockwood, 2010). Exclusionary fences may need to be erected and maintained, and pests and weeds controlled. Mowing in meadowland must be carefully timed to avoid breeding seasons. Plantations may have

to be removed to create open, semi-natural grasslands. In the context of climate change, plantings and relocations of species may be contemplated. Management will need to be adaptive. While it is legitimate for government to impose restrictions on development, it is a different matter for it to require landholders to actively manage land without payment in ways that conflict with their short-term economic interest. In these circumstances, incentives in the form of stewardship payments or payments for environmental services will have to be provided if conservation connectivity objectives are to be achieved (see Part II, section 3.5, below).

One public policy argument that could be used to counter private and community landholder claims that they should be paid incentives for active management is that they have a duty of care for their land which they should carry out without being paid by government. The extension of this argument would be that government should only pay for management actions over and above this duty of care. The difficult question is: how far does this duty of care extend? While owners of land may be prepared to concede that they should actively manage their land so as to prevent land degradation, groundwater pollution, acidification and salinisation, they are likely to resist any suggestion that they are responsible for active management for 'nature conservation' generally. Box I(3)-2 below gives an example of how the Australian states of Victoria and Queensland are addressing the issue of duty of care. 148

Box I(3)-2: Landholder duty of care in Australia

There is considerable discussion in Australia about the *rights* of landholders, but much less attention to their *responsibilities* in terms of land management. However, legislation in some states attempts to define a duty of care.

State of Victoria: The *Catchment and Land Protection Act* 1994 (s. 20(1)) in the state of Victoria provides,

> In relation to his or her land a landholder must take all reasonable steps to
>
> (a) avoid causing or contributing to land degradation which causes or may cause damage to land of another land owner; and
>
> (b) conserve soil; and
>
> (c) protect water resources; and
>
> (d) eradicate regionally prohibited weeds; and
>
> (e) prevent the growth and spread of regionally controlled weeds; and
>
> (f) prevent the spread of, and as far as possible eradicate, established pest animals.

This provision is enforced through the issue of land management notices (s 37). It is an offence to disobey a notice (s 41).

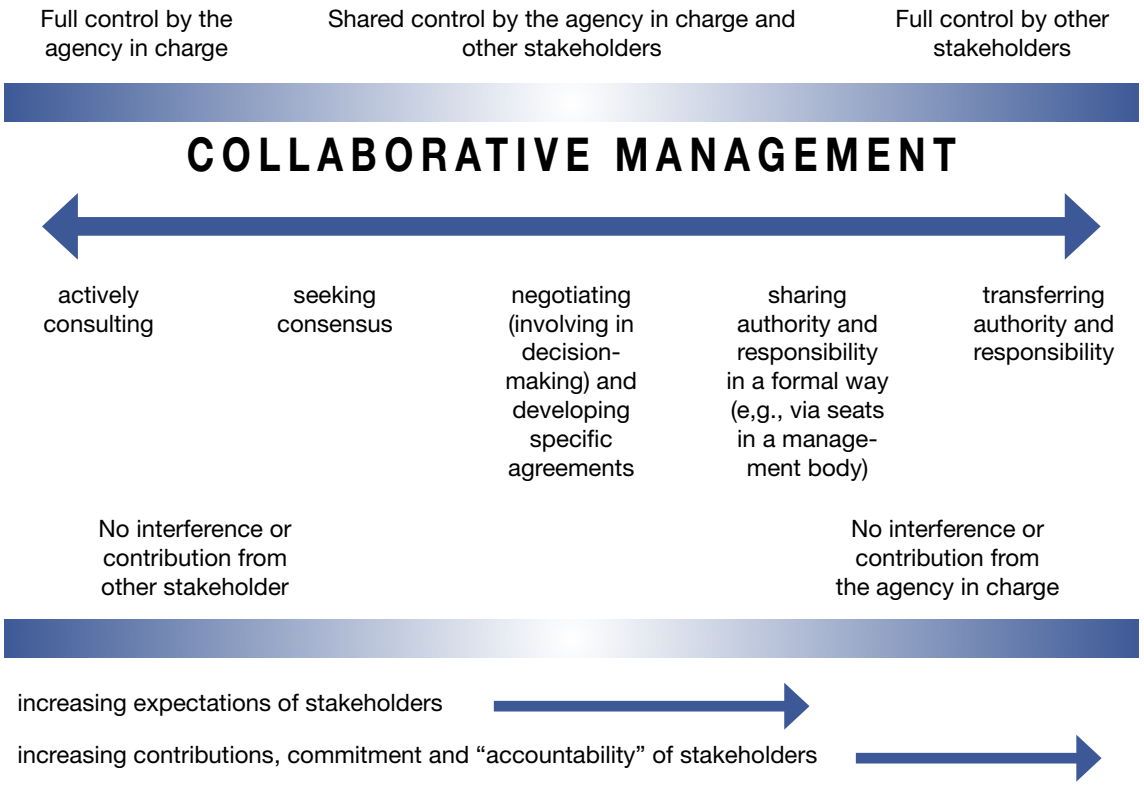
> The focus here is on preventing land degradation rather than harm to biodiversity. What this duty of care is attempting to do is to differentiate between landholder activities which cause harm to the community, which are prohibited, and those which deliver a community benefit, for which the community should pay. Yet what some might define as the provision of a public benefit, others might regard as the prevention of harm to the community.
>
> State of Queensland: The reach of the duty of care imposed by Queensland's *Environmental Protection Act* 1994 (s 319) is potentially much broader than Victoria's duty of care.
>
> A person must not carry out any activity that causes, or is likely to cause, environmental harm unless the person takes all reasonable and practicable measures to prevent or minimise the harm (the "general environmental duty").
>
> 'Environmental harm' is defined as any potential adverse effect on an environmental value (s 14). 'Environmental value' is defined to include "a quality or physical characteristic of the environment that is conducive to ecological health" (s 9). There is a compelling argument in the connectivity conservation context that connectivity is a quality of the environment that is conducive to ecological health.
>
> It is important to note, however, that the Queensland legislation, unlike the Victorian, allows the landholder simply to *minimise* environmental harm by employing all reasonable and practicable measures, as an alternative to *preventing* it. Moreover in deciding what is reasonable and practicable, the financial implications of the different measures have to be taken into account (s 319(2)).
>
> It is an offence under the Queensland legislation to cause serious or material environmental harm unless authorised by a licence, etc (ss 437-440). It is a defence to prove compliance with the general environmental duty. This includes complying with an approved code of practice (s 493A). Codes of practice are approved by the Minister and they state ways of achieving compliance with the general environmental duty (s 548).

3.2 Types of Governance

149 No single model of governance arrangements will work for all connectivity conservation areas, just as no single governance approach will work for all protected areas. Protected areas governance has increased in complexity, and governance arrangements for connectivity conservation areas present their own complexities because of the additional challenges posed. Under the classic form of protected areas governance, government takes responsibility for establishing and managing land that it already owns, holds in public trust, or has purchased. A similar scenario could be envisioned where government owns or controls lands or resources for connectivity conservation. However, a number of other forms of governance have been recognized in the protected areas context, and these could exist in connectivity conservation areas as well. In particular there is a range of regimes in which components of civil society collaborate with government in making decisions about establishment and management of protected areas (Lausche, 2011, p. 75-92). (See Box I(3)-3 below for an illustration of this continuum of possible collaborations).

Governance arrangements for connectivity conservation areas are likely to be dynamic and site-specific, and will evolve over time in response, for example, to changes in the partnerships involved, biophysical conditions (including climate change) and management needs (Worboys and Pulsford 2011, p. 18). A number of considerations affect the type of governance approach that may be most suitable to a particular connectivity conservation area. These include the spatial scale of the area, the levels of government involved and capacity for management, the role of NGOs, and whether land ownership or use rights are principally with government, private and corporate owners, or indigenous and local communities. These considerations are discussed below. 150

Box I(3)-3: Continuum of possible collaborations



Adapted from Source: Borrini-Feyerabend, 1996, p. 17

3.2.1 Scale

The spatial scale of a proposed conservation connectivity initiative (see Table I(1)-3) will be an important factor in determining governance arrangements. Governance initiatives carried out solely at the local level may be relatively straightforward, for example, where local government wants to protect hedgerows or preserve a creek-line as a wildlife corridor adjacent to a proposed development regardless of any direct nexus with protected areas. Even at a larger scale, however, a gap in connectivity may be small and easily addressed. A relatively small connectivity gap between two large protected areas on government-owned land or in a buffer around a particular protected area may be addressed by purchasing the land, or, if it is already in government ownership, by changing management practices. For example, connectivity between IUCN Category II protected areas (national parks) may be established by changes in management practices on intervening lands, qualifying them as IUCN Category V protected areas (protected landscape/seascape) (Yerena and Garcia-Rangel, 2010). (For a review of the IUCN protected area management categories, see Part II, Introduction, below.). 151

152 Once the biome shifts predicted to occur as a result of climate change are fed into the equation, then we are inevitably dealing with the issue of land management across very significant areas, such as the 'large-scale' connectivity areas envisaged by Worboys (2010, p. 5): tens of kilometres wide (or wider) and hundreds if not thousands of kilometres long. This is reflected in the Yellowstone to Yukon (Y2Y) initiative in the USA and the Great Eastern Ranges initiative in Australia. At this large scale, it has been suggested that the development of horizontal governance arrangements, such as partnerships and other examples of 'collaborative governance' are, in part, the result of the open-endedness and uncertainty associated with environmental issues, particularly in the context of climate change (Lockwood, 2010, p. 37).

3.2.2 Challenges with large scale areas

153 Where large scale connectivity conservation areas are involved, the challenges faced by protected area governance are magnified. This stems from a number of factors, including the following:

154 **A mixture of tenures:** in this paper, 'tenure' relates to who owns or controls land or resource rights in areas important for connectivity conservation. As discussed in the *IUCN Guidelines for Protected Areas Legislation*, tenure is a critical element for determining governance approaches for protected areas involving non-state owned or non-state controlled lands (Lausche, 2011, p. 99). Increasingly, protected areas are individually located not only on government lands but also on private, indigenous and community-owned lands. Particularly in large-scale connectivity areas, however, the *mixture* of tenures that are likely to be found presents a significant challenge. For example, the proposed Great Eastern Ranges corridor in Australia cuts across a number of state jurisdictions, and for New South Wales it is estimated that 37 per cent has protected areas status, 12 per cent is state forest, 4 per cent is other state-owned land and 48 per cent is private land (Pulsford et al., 2010). Indigenous peoples and local communities may also own land or have rights to use land or natural resources, grounded in constitutions, customary law or traditional practice, as well as legislation. Among the challenges, this mixture of tenures results in significant coordination issues (Pulsford et al., 2010; Hamilton and Trombulak, 2010).

155 **A range of stakeholders:** to coordinate actions across most large-scale connectivity areas it will be essential to facilitate cooperation between a large number of stakeholders. In contrast to the governance approach where a single agency is responsible for protected areas, there could be a range of interested government agencies, at both federal and state levels in some jurisdictions. Some may be directly responsible for managing areas of state-owned land or state-controlled land or resources (for example, national forests), others with regulatory responsibilities (for example, pollution control, fisheries management, agriculture, water management, mining) and others responsible for providing infrastructure (for example, roads, electricity). These agencies will be replicated where connectivity conservation areas span national boundaries. In addition, there are likely to be private landholders (individuals and corporations), including NGOs, who have purchased land for conservation, and, in some jurisdictions, communal title holders and indigenous communities with interests in land.

156 **A range of land uses:** there are likely to be a range of *current* land uses in connectivity conservation areas, some of them oriented towards nature conservation, some of them potentially compatible if modified (for example, sustainable forestry, grazing of native pastures), some of them largely incompatible and requiring remediation, including revegetation, if they are to become compatible (for example, areas cleared for intensive agriculture), and some completely incompatible (for example coastal high rise residential development). Attention must also be paid to *potential* uses, such as those identified as appropriate by a land use plan. For example, natural areas may be threatened

by proposed residential development. From a connectivity conservation perspective, many current agricultural uses are likely to be preferable to urban development in that they may keep connectivity conservation options open for the future.

A significant economic dimension: in the classic approach to protected area governance, where the state directly owns or controls the area, economically productive human activity was typically excluded. It is true that this approach is being gradually modified, particularly in developing countries by the evolution of indigenous and community conserved areas (Phillips 2003), where sustainable human use is a recognized imperative. However, there must still be a primary commitment in these areas to nature conservation. The same commitment may not be present in relation to connectivity conservation areas, where productive use may be ubiquitous, particularly on land in private ownership, and sometimes intensive. Ongoing tensions with nature conservation need to be managed adaptively, particularly in light of current uncertainties relating to the impacts of climate change. But such an approach is likely to create investment uncertainties for producers. 157

Uncertain government commitment: while there is considerable international pressure on jurisdictions to set aside protected areas and for government to take the lead, connectivity conservation is still very much a work in progress, both as regards the underlying science and the appropriate policy responses, including governance. In these circumstances, some governments, faced with the complexities of land use and management in connectivity conservation areas, and in particular the issue of private land management, may be happy to vacate the leadership role, allowing NGOs to fill the vacuum. In the USA, in spite of the fact that the federal government owns significant areas of land along the Western spine of the country, NGOs have been a driving force behind the development of the Yellowstone to Yukon corridor (Y2Y) (Locke, 2010). 158

Drawing from these factors, two crucial variables for determining governance arrangements are likely to be: 159

- whether government is prepared to take the initiative in developing a connectivity conservation area, or leaves this role to civil society, and
- the type(s) of land tenure occurring in the proposed connectivity conservation area.

3.2.3 Bottom-up and top-down strategies

A bottom-up approach to connectivity conservation management is increasingly being recognized by conservation managers as appropriate for effective on-the-ground management. Such an approach has been characterised as follows: 160

> It is socially inclusive, it is based on a guiding vision and governance principles of subsidiarity and polycentricism, though it sustains a participatory involvement and social investment by governments at all levels (Worboys and Pulsford, 2011, p. 22).

An IUCN background paper has found that many jurisdictions in South America and Europe pursued connectivity conservation initiatives at a sub-national level, with bottom-up strategies at the local level being very important. It concludes (Moore and Shadie, 2007, p. 7): 161

> 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.

Indeed, the bottom-up approach is sometimes elevated to a principle of *good* governance in the form of the 'subsidiarity principle'. The IUCN World Commission on Protected Areas defines this principle as the allocation of management authority and responsibility "to the institutions closest to the resources 162

at stake" and advocates it as a principle of good governance in the context of protected areas management (Dudley, 2008, p. 28). However, in the connectivity conservation context, the significance of the principle of subsidiarity will depend on the precise circumstances.

163 Subsidiarity may make a great deal of sense where indigenous or community managers have traditionally managed land in ways sensitive to nature conservation or where connectivity conservation initiatives are taken by civil society rather than government (see below). It can be used as a vehicle for providing indigenous and local communities with increased rights and responsibilities (SCBD, 2011, p. 25). Even here, however, the case for decentralisation needs to be assessed on a case-by-case basis. In Indonesia, for example, decentralisation to district level by some accounts has led to increased authority but reduced expertise, capacity and infrastructure and conflicts over natural resource management between districts (Inung, 2010, p. 139). Recent connectivity conservation guidance to managers on the issue of decentralization also is cautious:

> Decentralization can also make it more difficult for non-local interest-holders to effectively express their values and have them considered in decision-making processes. It is contrary to good governance if the legitimate empowerment of local interests disenfranchises non-local conservation advocates (Lockwood, 2010, p. 39, in Worboys et al., 2010).

164 Where connectivity conservation initiatives are taken by governments in developed economies, it cannot be assumed that local government should take the lead. In many jurisdictions, local government has an established tradition of involvement in land use planning and development control, legitimised by its electoral accountability. However, the role of local government in establishing and managing large-scale connectivity areas, as distinct from local wildlife corridors, is inevitably inhibited by the very restricted spatial jurisdictions of local governments, and the traditional perception of nature at this level of government as a local amenity rather than human heritage. The politico-legal boundaries delimiting local government areas are often quite insensitive to natural resource units such as catchments or bioregions. In addition, local councils may lack multidisciplinary capacity and their traditional focus in developed economies has been on economic growth through facilitating development rather than nature conservation (Zunckel, 2010, p. 83).

165 Available research suggests "that the concurrent involvement of both central and local or regional government is crucial to securing the benefits of decentralisation" (Lane et al., 2004, p. 113). In addition to making policy commitments and investing in connectivity conservation initiatives, central governments are likely to have an important role to play in putting in place relevant legal settings. In many countries where the focus in the past has been on conservation management of land in public ownership, new legislation may have to be enacted or existing legislation, such as land use planning legislation, amended to facilitate connectivity conservation across the landscape.

166 In federal systems, the constitutional allocation of powers to enact legislation may be another factor in determining which level of government takes the leadership role in connectivity conservation. In Australia, for example, the constitutional position has led to the states rather than the federal government being regarded as the de facto manager of natural resources. It is the states on the east coast that are collaborating with NGOs in attempts to develop the Great Eastern Ranges connectivity conservation area.

3.2.4 The role of NGOs

NGOs are taking significant leadership roles in governance and decision-making supportive of connectivity conservation initiatives. According to some research, virtually all ecological network programmes in the USA and many parts of Asia and the Pacific are being initiated and managed by NGOs (Bennett and Mulongoy, 2006). So too were most in Latin America. More recent literature confirms that this continues to be the case in the USA, with government slow to assume an increased role (Irwin, 2010; Locke, 2010). Only in Western Europe were connectivity conservation programmes being developed primarily through government leadership (Bennett and Mulongoy, 2006,pp. 28, 44, 56, 83). 167

For NGOs to have an effective role in guiding or aiding governance approaches for a specific connectivity conservation area, a crucial first step is for such organisations to gain the support and trust of the landholders concerned, whether private owners, local and indigenous communities, or specific resource rightsholders. This comes through a process of communication and negotiation, education and persuasion. A shared understanding and vision of the aims of the particular connectivity conservation area and the local impacts and benefits from the designation need to be developed with community leaders, frequently with local facilitators (Moore and Shadie, 2007, p. 10). Consensus building is critical. An evaluation of the Mesoamerican Biological Corridor by the World Resources Institute in 2001, for example, concluded that consensus amongst stakeholders, including public agencies at local, regional and national levels, the private sector, conservationists, and rural and indigenous populations, was the key to the initiative's success. Supportive communities are essential (Chettri et al., 2010; Muller et al., 2010). In addition, incentives are often needed (see Box I(3)-4, below). 168

Box I(3)-4: Incentives

In many Asian, South American and African countries, the need for a supportive community has led to NGOs combining biodiversity conservation with initiatives to develop sustainable livelihoods (Bennett and Mulongoy, 2006, pp. 56, 70, 80, 88-89; Hofstede, 2010; Surkin et al., 2010; Fernandez et al., 2010). ,In the USA, a backlash from communities dependent on resource extraction led to the Yellowstone to Yukon initiative incorporating a reference to healthy human communities (Locke, 2010, p. 171).

This may not, however, be enough to persuade communities to cooperate where connectivity conservation imperatives contemplate restrictions on their activities that limit short-term economic opportunities. In these circumstances, it becomes essential to provide local land and resource owners with financial incentives to adopt appropriate stewardship practices. For example, in Madagascar, Conservation International offers development benefits such as technical support for agriculture, income-generating benefits, education and health services in exchange for conservation activities along biodiversity corridors (ELI, 2011, p. 139). However, where funding and other support is initially provided by international financial institutions, foreign donors, private foundations and research institutes, there is no guarantee of long-term security.

In many situations, NGOs may have an advantage when it comes to building trust and partnerships with local landholders in proposed connectivity conservation areas because they do not have the option of using direct regulation. The threat of direct regulation by government is hardly conducive to building new partnerships. However, government still has an important role to play in facilitating NGO initiatives by providing the relevant legal and policy setting and tools. Direct regulation may still have a crucial role to play in setting out the broad parameters within which NGOs are able to conduct more detailed negotiations about the provision of specific actions and incentives. For example, the crucial importance of the existing wildlife laws to the Yellowstone to Yukon initiative in the USA has been emphasised as part of the package of tools, with incentives and voluntarism, that had a significant positive effect on the outcome (Locke, 2010, p. 179). Others have drawn attention to the importance of government regulation for clearing native vegetation in the development of the Gondwana link in Western Australian. This regulation removed "a major negative influence on both the landscape and 169

people's morale" (Watson et al., 2010, p. 112). In Western Europe, in the limited situations where NGOs have taken a pro-active role in ecological network initiatives, they have still relied heavily on government to secure the action (Bennett and Mulongoy, 2006, p. 44).

3.2.5 Land tenure factors

170 A potential connectivity conservation area may already be in government ownership or control and substantially intact from a nature conservation perspective. Examples could be an army shooting range or native forest traditionally managed for timber production. A change of management agency and management regime may qualify the area as an IUCN protected area in its own right while at the same time meeting connectivity conservation needs in relation to existing protected areas. So, for example, in south eastern NSW connectivity conservation objectives have been advanced significantly by transferring native forest, previously managed by the forestry agency, into the national park estate. A related initiative has seen the development of cross-border connectivity conservation management arrangements involving protected areas that are already structurally connected in the neighbouring state of Victoria and the Australian Capital Territory, based on a memorandum of understanding between the three governments.

171 Where public land is left under the control of an agency whose principal brief is for natural resource exploitation, it may still be possible for the agency to play an important role in advancing connectivity conservation objectives if adjustments to management practices can be negotiated at an inter-agency level. For example, production forests subject to sustainable forestry management practices, such as rotation cycles, might be areas that support connectivity conservation (Worboys, 2010, p. 7). The appropriate vehicle would be a management plan signed off by both agencies after being exhibited for public comment. In negotiating such arrangements, the nature conservation agency's bargaining power will be enhanced by any powers it possesses to regulate forestry practices in production forests, for example, to protect threatened species. In addition, with the potential commercial opportunities presented by carbon sequestration and other environmental services, forestry agencies are rethinking their traditional focus on resource extraction in favour of more sustainable forest management practices which may also benefit connectivity conservation (see discussion on legal tools for sustainable forestry in Part II, section 3.1.7, below).

172 Apart from the forestry agency, other government agencies may have direct interests in public land that is valuable for connectivity conservation. In Australia, for example, this would include the agency responsible for managing unalienated public land, much of which is leased for private use; the agency responsible for granting mining leases; and agencies responsible for constructing roads and powerlines which might create gaps in connectivity. This underscores the need for a cross-sectoral approach to connectivity conservation, with clear responsibilities allocated for coordination and decision-making (Moore and Shadie, 2007, p. 9).

173 A new set of governance challenges emerges when government does not own or control the land or natural resources concerned, or may only own or control part of them. In these circumstances, it may be optimal for civil society to take the lead, but government inevitably has a role to play in setting the legal parameters and providing funding (see above). As a basic minimum, government needs to underpin local community and NGO initiatives by making a firm policy commitment to conservation not only in protected areas but at a landscape and seascape level, including a commitment to connectivity conservation (Moore and Shadie, 2007, p. 8; Lockwood, 2009, p. 170).

3.2.6 Choosing instruments

When the land important for connectivity conservation is not state-owned or state-controlled, the choice of policy instruments by government to require or encourage landholders to cooperate is a critical decision. In this context, the cooperation of landholders cannot be taken for granted. Available policy instruments include land purchase, direct regulation (with or without compensation), voluntary agreements and economic instruments, such as incentives and tradable permits. These are discussed in Part II, sections 3.2 through 3.5, below. 174

The approach taken and choice of suitable policy instruments will vary depending on the context. In both developed and developing economies, most private landholders are ordinarily engaged in market-driven production from their lands and are likely to resist modifications to land management regimes that would promote connectivity conservation where those modifications are likely to compromise the profitability of their enterprise. In some countries, for example, in Eastern Europe, the privatisation of land may be seen to be a direct threat to connectivity conservation objectives (Bennett and Mulongoy, 2006, pp. 20-21). Whether government chooses to rely on voluntary instruments, such as voluntary agreements and incentives, or on direct regulation, will have a significant bearing on the governance regime that emerges. 175

The voluntary cooperation of indigenous communities and some local communities in developing countries can be more readily assumed because their traditional and current interests and livelihoods are more likely to be compatible with connectivity conservation objectives. Here, indigenous people rather than governments are often viewed as being the most effective stewards of forest resources. As a result, their full and effective participation in decision-making, based on the UN Declaration of the Rights of Indigenous Peoples, and their share in an equitable distribution of benefits (including shares in sustainable logging receipts and payments for carbon sequestration and other ecosystem services) are seen to be essential. This has been recently emphasised in relation to REDD+ initiatives (see Part I, section 2.4 above, and Part II, sections 1.2 and 3.5.3 below for more discussion of REDD+). 176

Key messages

Governance arrangements for connectivity conservation are still in the early stages of development. Significant challenges are posed where connectivity conservation areas cover a mixture of land and resource tenures and uses and involve a range of stakeholders, which will often be the case. These challenges are surmountable, however, and lessons are already being learned from case studies and research on how to identify critical connectivity conservation areas, their specific management needs, and governance options for addressing those needs. The law has an essential supporting role to play in these advances. 177

The conventional approach to protected area governance – state-owned or state-controlled areas – is unlikely to be significant in the connectivity conservation context. In addition, individual parcels of private or community land, where all the land is owned by an individual, community or NGO, are unlikely, by themselves, to meet large-scale connectivity needs. Instead, large-scale areas will normally have many tenure types and uses. The effectiveness of large-scale initiatives covering a range of tenures and uses will depend upon partnerships between civil society, the private sector and national and local governments and other authorities. This is an approach being increasingly recognized in protected areas governance, with insights and lessons already being gained for connectivity conservation. 178

Governments have an important role to play as catalysts and facilitators and putting in place supportive legal, policy, and financial mechanisms for connectivity conservation. These mechanisms should include 179

direct regulation to prevent degradation of important connectivity conservation areas, for example, through legislation controlling forestry and agricultural practices, and the removal of native vegetation. Such mechanisms also should include enabling legislation to provide incentives for connectivity restoration and conservation by landholders.

180 NGOs have a crucial role to play helping to identify and promote connectivity conservation needs, advising on land management consistent with those conservation needs, stimulating voluntary cooperation by affected and interested landholders, and where opportunities and capacity exist taking on responsibilities to manage lands and resources for connectivity conservation.

181 In some country settings, the interests and livelihoods of indigenous communities and some local communities may be more compatible with conservation connectivity objectives than those of private landholders. To the extent that this is the case, such situations will have significant implications for governance arrangements. Bottom-up initiatives that empower local communities are more likely to succeed where landholders' self-interests lead to cooperation. Yet government still has an important role to play in putting in place a supportive legal and policy setting. This may, for example, include regulations designed to prevent degradation of the land and its natural resources, paving the way for legally-binding voluntary land use management agreements, and providing incentives for landholders and rightsholders to enter into those agreements.

Part II – Legal issues and instruments for connectivity conservation

Introduction

The legal focus of this Part is on land and sea areas that serve important connectivity functions particularly for protected area systems and networks, yet are not and may never become formal protected areas. As discussed in Part I, in recent decades scientific understanding has advanced considerably concerning important principles and management practices for connectivity conservation as part of biodiversity conservation. Law and policy tools and techniques are still emerging. As characterized by one connectivity conservation study: 182

> The ecological aspects of connectivity conservation have been subject to considerable research, and while there are doubtless still deficiencies in relevant data, there are practical recommendations for areas which merit urgent protection. The most critical obstacle is not ecological information, but political and financial support. (Buckley, 2008, p. 76). (emphasis added)

There are a variety of legal tools and approaches in most legal systems already available to be used as is or with some modifications to support connectivity conservation. What is already known about the science and management of connectivity conservation provides a rich foundation of concepts and principles to incorporate in such legal tools. The translation of connectivity conservation science and management into effective policy and law is the challenge which this Part aims to address. 183

Protected areas legal frameworks as baseline. Research on legal aspects of connectivity conservation begins with a country's protected areas legal framework. As elaborated in Part I, section 1 above, management of areas for connectivity conservation is defined according to the specific connectivity needs of individual protected areas as they interact with each other to support biodiversity and ecosystem goals and the needs overall of the protected area system or network. Connectivity conservation areas should never be a substitute for formal protected areas, and legal provisions for connectivity conservation should make this clear. At a country level, connectivity conservation may be defined primarily by the nation's biodiversity conservation needs. However, at subnational and local levels, connectivity conservation areas are linked to the connectivity needs of the particular protected area and protected areas system they support. Thus, it is important to know the protected areas legal framework, particularly how protected areas are defined and classified according to different conservation objectives. 184

It also should be stressed that protected areas and protected area systems and networks may themselves be designed to serve as a direct tool for connectivity. The Natura 2000 sites within the European Union are an example (see Section 2.2 of this Part below). The most critical connectivity areas should be brought into the formal protected area system wherever possible. 185

In that context, it is useful to briefly review the internationally-recognized definition of a protected area and its main management categories. A protected area, as defined by IUCN, is: "a clearly defined geographical space, recognized, dedicated and managed, through legal or other effective means, to achieve the long-term conservation of nature with associated ecosystem services and cultural values" (Dudley, 2008). Protected areas that meet this definition may range from land or marine sites receiving strict protection to areas serving multiple purposes and conservation objectives. IUCN has elaborated six categories of protected areas by management objectives and today they are recognized as the international system for classifying protected areas (see Table II-1). The IUCN definition and this system 186

of categories are important to incorporate in modern protected areas legislation, as discussed in the *IUCN Guidelines for Protected Areas Legislation* (Lausche, 2011). The World Database of Protected Areas, a joint project of UNEP-WCMC and IUCN WCPA, uses the system to record both terrestrial and marine national protected areas.

187 These management categories are independent of who owns, controls, or has responsibility for management. That issue relates to governance and, as discussed in Part I, section 2, above, there are several governance possibilities for land, water, and natural resources management and conservation that may be used alone or in combination. IUCN recognizes four broad types of governance for protected areas (Dudley, 2008):

- governance by government
- shared governance
- private governance
- governance by indigenous peoples and local communities

Table II-1: IUCN protected area management categories

Category	Definition by management objectives
Category Ia: Strict nature reserve	Strictly protected areas set aside to protect biodiversity and also possibly geological or landform features, where human visitation, use and impacts are strictly controlled and limited to ensure protection of conservation values. Such protected areas may serve as indispensable reference areas for scientific research and monitoring.
Category Ib: Wilderness area	Usually large unmodified or slightly modified areas, retaining their natural character and influence without permanent or significant human habitation, which are protected and managed so as to preserve their natural condition.
Category II: National park	Large natural or near-natural areas, set aside to protect large-scale ecological processes along with the complement of species and ecosystems characteristic of the area, which also provide a foundation for environmentally and culturally compatible spiritual, scientific, educational, recreational and visitor opportunities.
Category III: Natural monument or feature	Protected areas set aside to protect a specific natural monument, which can be a landform, sea mount, submarine cavern, geological feature such as a cave or even a living feature such as an ancient grove. They are generally quite small protected areas and often have high visitor value.
Category IV: Habitat/species management area	Protected areas aimed at protecting particular species or habitats, and management. Many category IV protected areas will need regular, active interventions to address the requirements of particular species or to maintain habitats, but this is not a requirement of the category.
Category V: Protected landscape/seascape	Protected areas where the interaction of people and nature over time has produced an area of distinct character with significant ecological, biological, cultural and scenic value, and where safeguarding the integrity of this interaction is vital to protecting and sustaining the area and its associated nature conservation and other values.
Category VI: Protected area with sustainable use of natural resources	Protected areas that conserve ecosystems and habitats, together with associated cultural values and traditional natural resource management systems. They are generally large, with most of the area in a natural condition, where a proportion is under sustainable natural resource management and where low-level non-industrial use of natural resources compatible with nature conservation is seen as one of the main aims of the area.

Source: Lausche, 2011, p. 27, taken from Dudley, 2008, pp. 13–23.

Recent legal studies on connectivity conservation. Two recent legal studies on connectivity provide useful insights and early lessons on approaches being taken by countries and important elements to consider. The first study, published in 2006, is one of the few efforts that could be found to evaluate specific laws for their capacity to implement terrestrial connectivity as part of protected areas networks. Researchers working out of the University of Guelph, Canada, evaluated the capacity of Canadian and American legislation to create an ecologically functional Algonquin-Adirondack protected area network in Ontario and New York State, analysing international treaties, national laws, and provincial and state laws and their regulations (Vásárhelyi and Thomas 2006). The study found a general lack of legislative provisions to implement terrestrial networks because most legislation did not explicitly identify ecological criteria to be used for the design and management of such networks (p. 47). It noted that the ecosystem-based management approaches adopted in policy in the USA and Canada had not, for the most part, been translated into legislation, despite intentions to conserve biodiversity (p. 51). 188

Drawing upon scientific principles, the study used general and specific ecological criteria such as scale and size at the landscape level and for individual species populations, larger ecosystem-based needs within which protected areas and their linkages are located, ecological change including from climate change, migratory pathways, and types of habitats needing protection. Its general conclusion, broadly applicable, was that protected areas legislation, without explicit ecological criteria, would not be adequate to ensure that networks would comprise the ecological features needed to confer long-term ecological integrity (p. 53). Because connectivity science has progressed much faster than most laws and regulations, much of today's legislation needs to be amended to be more conducive to achieving ecological networks of protected areas (p. 53). 189

Finally, this study stressed the essential science-law connection: 190

> Planning a network on ecological grounds and realizing the network under law… requires collaboration between the disciplines of law and ecology (p. 47).

A second legal study published in 2007 was undertaken jointly by the IUCN World Commission on Protected Areas (WCPA) and IUCN Commission on Environmental Law (WCEL) (Moore and Shadie, 2007). That study undertook research and surveys on the legal approaches of different countries to support biodiversity connectivity. The project found a number of countries were pursuing connectivity initiatives under various names (for example, corridors, biological corridors, ecological corridors. ecological networks, protected landscapes, eco-corridors). The most common approach was to include connectivity in other legislation addressing such topics as nature conservation, protected areas, biodiversity, wildlife, or forests (see Table II-2,below). Also, it found that a variety of planning tools, local government powers, and other types of legal instrument were used in some countries to promote connectivity conservation on private land, for example, incentives such as tax concessions, grants, technical support and materials, development concessions, management agreements, environmental levies, and developer contributions. (The study is discussed in that context in Part II, section 3.2, below) A range of institutional players are involved, often in collaboration, including supra-regional authorities, national, provincial/state, or municipal authorities, and non-governmental organizations. 191

Importantly, for the purposes of this paper, an overarching conclusion focused on the essential link between science and law: 192

> 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 (Moore and Shadie, 2007, p. 11).

Table II-2: Legal approaches to 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-na-tional law					
Bhutan		✓						
Bolivia								✓
Brazil			✓					
Bulgaria					✓			
Canada		✓						
Denmark				✓				
Ecuador		✓ municipal ordinances						
Germany						✓		
Hungary				✓		✓		
India							✓	
South Korea		✓						
Lithuania			✓					
Neth-er-lands				✓				
Poland						✓		
Slovakia						✓		
Ukraine	✓							
Venezuela					✓			

Source: Moore and Shadie, 2007.

Organisation of this Part

193 This Part begins with an overview of selected international and regional law instruments that support or raise obligations for connectivity conservation, mostly in terrestrial environments (marine treaties

are covered in a separate marine section at the end of this Part in section 4). Section 1 addresses major global treaties, including the Convention on Biological Diversity, UN Framework Convention on Climate Change (UNFCCC), Convention on the Conservation of Migratory Species of Wild Animals, Convention on Wetlands of International Importance especially as Waterfowl Habitat (Ramsar), and Convention Concerning the Protection of the World Cultural and Natural Heritage (World Heritage Convention). Section 2 moves on to a selection of regional law instruments that are particularly relevant for connectivity conservation, such as the African and Bern Conventions. A review of European Union law as it supports connectivity conservation is included.

Section 3 of this Part turns to national policy and law instruments, the largest segment of the Part. The discussion begins with an introduction to the range of possible legal tools and approaches that may be available for connectivity conservation in most legal systems. It then moves on to major areas of law with potential to support connectivity conservation. The section is divided into five subsections (3.1 through 3.5) to distinguish the different themes being covered: conservation and sustainable use, land use planning, development control, voluntary conservation agreements, and economic instruments.Some of the instruments discussed in this section may provide obligations and mechanisms for connectivity conservation directly (for example, protected areas law). Others may establish requirements that make connectivity an important consideration if the objectives of the legislation are to be achieved over the long term (for example, land use planning law). Still others provide the impetus and tools for voluntary conservation actions to support connectivity (for example, economic instruments). 194

Finally, section 4 singles out and reviews special issues that arise with connectivity conservation and law in marine environments. Following the general approach of the *IUCN Guidelines on Protected Areas Legislation*, where legal aspects of marine protected areas also were given special attention in a separate chapter that drew from and built upon the generic guidelines, it was considered necessary here to bring similar attention to the special features of marine environments and law that need attention for effective connectivity conservation. Legal tools and techniques for marine connectivity are much less advanced than for terrestrial environments. In part, this is because scientific understanding about the operation of marine environments is in its infancy and law and policy is much less developed. The special features of marine environments are critical considerations for how law can be used most effectively for marine connectivity conservation. These features include the special nature and interactive behavior of marine ecosystems and marine life throughout the planet's oceans; the many interactive dimensions at different levels from the surface through the water column to the ocean bottom; land and sea interactions; special management challenges involving different uses, jurisdictions and disciplines; and importantly for this project the over-arching international law regime of the United Nations Convention on the Law of the Sea and emerging marine elements in other international and regional treaties. Section 4 of this Part builds on Part I and the other sections of Part II and should be read together with those sections. 195

1 International law – global instruments, terrestrial environments

This section reviews a number of international legal instruments with a global scope mostly focused on terrestrial environments which, directly or indirectly, promote connectivity conservation. It discusses pertinent (legally binding) treaty provisions, decisions by the Parties such as COP decisions (which are generally non-binding), and other guidance provided within the context of the instruments concerned. A more general discussion of these global treaties and their significance for protected areas networks can be found in the *IUCN Guidelines for Protected Areas Legislation*. As noted in the introduction to 196

this paper, many of the international instruments discussed in this section have general obligations and principles that apply to both terrestrial and marine environments. However, because of the special nature of marine environments, there are established and emerging legal principles and guidelines specifically for marine environments that are critical for understanding law and marine connectivity conservation which are covered in section 4 at the end of this Part.

197 It should be borne in mind that treaty provisions must be interpreted in light of the treaty's objectives and taking into account any "subsequent agreements" or "subsequent practice" by the Parties regarding their interpretation and application. This principle is in conformity with Article 31 of the Vienna Convention on the Law of Treaties (1969) and customary international law. As regards interpretation in light of the aims of nature conservation treaties, it is of significance that, both generally speaking and particularly as a consequence of climate change, effective conservation can hardly be achieved without maintenance or restoration of adequate connectivity (see Part I above). Interpretation with reference to 'subsequent agreements' or 'subsequent practice' also means that COP decisions regarding connectivity, although themselves non-binding, may influence the interpretation of binding treaty obligations. It should also be kept in mind that treaty obligations may not only have effect within the sphere of public international law – as obligations of states *vis-à-vis* other states – but also within the sphere of domestic legal systems. The extent to which this is the case varies from one national legal system to the other. In some countries, international law is part of the domestic legal system, and takes precedence over conflicting rules of national origin. In other countries, international rules must be transposed into national legislation before taking effect within the domestic sphere.

1.1 Convention on Biological Diversity

198 Connectivity conservation is not addressed in so many words in the Convention on Biological Diversity (CBD) (1992). Several provisions are nevertheless of relevance to the topic, particularly the following paragraphs of Article 8 on *in-situ* conservation:

Each Contracting Party shall, as far as possible and as appropriate:

(a) Establish a system of protected areas or areas where special measures need to be taken to conserve biological diversity;

(b) Develop, where necessary, guidelines for the selection, establishment and management of protected areas or areas where special measures need to be taken to conserve biological diversity;

(c) Regulate or manage biological resources important for the conservation of biological diversity whether within or outside protected areas, with a view to ensuring their conservation and sustainable use;

(d) Promote the protection of ecosystems, natural habitats and the maintenance of viable populations of species in natural surroundings;

(e) Promote environmentally sound and sustainable development in areas adjacent to protected areas with a view to furthering protection of these areas;

(f) Rehabilitate and restore degraded ecosystems and promote the recovery of threatened species, inter alia, through the development and implementation of plans or other management strategies;

(l) Where a significant adverse effect on biological diversity has been determined pursuant to Article 7, regulate or manage the relevant processes and categories of activities.

199 From the perspective of connectivity conservation, it is significant that Article 8 refers to a 'system' of protected areas and *other* "areas where special measures need to be taken to conserve biological

diversity." Other germane provisions include the duties in Article 6 to develop national biodiversity strategies or plans and, as far as possible and as appropriate, to integrate biodiversity conservation into other "relevant sectoral or cross-sectoral plans, programmes and policies." The latter obligation must be deemed to apply, for example, to infrastructural and agricultural policies, which evidently have far-reaching implications for connectivity conservation.

200 These Convention provisions have come to be accompanied and informed by a growing set of non-binding commitments and guidelines adopted by the CBD Conference of the Parties (COP), including with respect to climate change adaptation and protected areas networks. These reveal that CBD Parties attach considerable significance to connectivity in the implementation of Convention obligations. For instance, the eleventh of the so-called Aichi Targets, laid down in the Strategic Plan for Biodiversity 2011-2020 (COP Decision X/2, 2010, Annex), reads:

> By 2020, at least 17 per cent of terrestrial and inland water areas, and 10 per cent of coastal and marine areas, especially areas of particular importance for biodiversity and ecosystem services, are conserved through effectively and equitably managed, ecologically representative and *well connected systems of protected areas* and other effective area-based conservation measures, and integrated into the wider landscapes and seascapes. (emphasis added.)

201 This target builds on the CBD Programme of Work on Protected Areas (COP Decision VIII/28, 2004, Annex), among other things. That decision, under Goal 1.2, calls for the establishment and management of "ecological networks, ecological corridors and/or buffer zones, where appropriate, to maintain ecological processes and also taking into account the needs of migratory species" (para.1.2.3; see also paras. 1.2.1, 1.2.4 and 1.2.5). Furthermore, according to the fifth Aichi Target, by 2020 the rate of loss of natural habitats should be "at least halved and where feasible brought close to zero, and degradation *and fragmentation* [should be] significantly reduced" (emphasis added).

202 In a 2010 COP decision on protected areas (Decision X/31, 2010), Parties resolved to "[e]nhance the coverage and quality, representativeness and, if appropriate, connectivity of protected areas" as a contribution to the establishment of "representative systems of protected areas and coherent ecological networks" (para. 1(a)). In the context of climate change, the same decision calls for "concerted efforts to integrate protected areas into wider landscapes and seascapes and sectors, including through the use of connectivity measures such as the development of ecological networks and ecological corridors, and the restoration of degraded habitats and landscapes in order to address climate-change impacts and increase resilience to climate change" (para. 14(a)). Also in connection with ecosystem restoration, Decision X/31 urges Parties to employ, as appropriate, "connectivity tools such as ecological corridors and/or conservation measures in and between protected areas and adjacent landscapes and seascapes" (para. 26(a)).

203 In addition, in order to help species and ecosystems adapt to climate change, a COP decision on this topic (Decision X/33, 2010) summons CBD Parties to strengthen protected areas networks "including through the use of connectivity measures such as the development of ecological networks and ecological corridors and the restoration of degraded habitats and landscapes" (para. 8(d)(iii)), and to integrate biodiversity "into wider seascape and landscape management" (para. 8(d)(iv)). Earlier COP decisions had already called on Parties to "take measures to manage ecosystems so as to maintain their resilience to extreme climate events and to help mitigate and adapt to climate change" (Decision VII/15, 2004, para. 12); to "integrate climate change adaptation measures in protected area planning, management strategies, and in the design of protected area systems" (Decision VII/28, 2004, para. 1(4)(5)); and to "cooperate regionally in activities aimed at enhancing habitat connectivity across ecological gradients, with the aim of enhancing ecosystem resilience and to facilitate the migration and dispersal of species with limited tolerance to altered climatic conditions" (Decision VIII/30, 2006, para 4).

204 The CBD COP 11, convened in October 2012 in Hyderabad, India, reaffirmed the importance of connectivity as part of forest activities for climate change mitigation. In its decision on biodiversity and climate change related issues, the Parties provided guidance in the decision's annex with respect to designing, implementing and monitoring afforestation for climate change mitigation. Specifically, the guidance calls upon Parties to "consider conservation of biodiversity and ecosystem services through, for example…[s]trategically locating afforestation activities within the landspe to enhance *connectivity* and increase the provision of ecosystem services within forest areas" (emphasis added). (CBD COP 2012, Annex, para. 17(d)(v)).

205 Finally, detailed guidance for Parties regarding conservation connectivity, whether or not in the context of climate change, is provided in a large number of volumes published over the years in the CBD Technical Series. Particularly relevant titles are indicated in Table II(1)-1 and available at https://www.cbd.int/ts).

Table II(1)-1: CBD Technical Series volumes which are key to connectivity conservation

Number of Series	Title
10	Inter-linkages between Biological Diversity and Climate Change (2003)
15	Biodiversity Issues for Consideration in the Planning, Establishment and Management of Protected Area Sites and Networks (2004)
18	Toward Effective Protected Areas Systems (2005)
23	Review of Experience with Ecological Networks, Corridors and Buffer Zones (2006)
24	Closing the Gap: Creating Ecologically Representative Protected Area Systems (2006)
29	Emerging Issues for Biodiversity Conservation in a Changing Climate (2007)
35	Implementation of the CBD Programme of Work on Protected Areas: Progress and Perspectives (2008)
41	Biodiversity and Climate Change Mitigation and Adaptation: Report of the Second Ad Hoc Technical Expert Group on Biodiversity and Climate Change (2009)
42	Review of the Literature on the Links between Biodiversity and Climate Change – Impacts, Adaptation and Mitigation (2009)
44	Making Protected Areas Relevant: A Guide to Integrating Protected Areas into Wider Landscapes (2010)
51	Biodiversity and Climate Change: Achieving the 2020 Targets (2010)

1.2 Climate Change Convention

206 Despite the close linkages between biodiversity conservation and climate change, the UN Framework Convention on Climate Change (UNFCCC) (1992) and its associated Kyoto Protocol (1997) provide little guidance regarding the adaptation of biodiversity to climate change. In general terms, Article 3(3) of the Climate Change Convention prescribes the taking of "precautionary measures" to mitigate the adverse effects of climate change. Furthermore, Article 4(1)(b) requires the formulation and implementation of national or regional programmes containing "measures to facilitate adequate adaptation to climate change." In the words of one study, the UNFCCC thus contains an "obligation to undertake anticipatory, planned adaptation measures" and "does not allow for Parties to rely on the autonomous adaptation of systems" (Verheyen, 2002, p. 131). The relevant provisions of the UNFCCC and the Kyoto Protocol do not, however, specifically address adaptation of species and ecosystems.

All the same, the mechanisms created to further the implementation of the Convention and the Protocol present opportunities to enhance connectivity conservation. The so-called REDD+ scheme is a case in point, the abbreviation standing for **R**educing **E**missions from **D**eforestation and Forest **D**egradation, conservation of forest carbon stocks, sustainable management of forests and enhancement of forest carbon stocks in developing countries. REDD first appeared as an item on the agenda of the UNFCCC COP in 2005, and is related to the implementation of Articles 2; 3(1), (3) and (4); and 4(1)(a)-(d), (3), (5) and (7) of the Convention. It is intended to complement the Clean Development Mechanism (CDM) established under the Kyoto Protocol, which is limited to afforestation and reforestation projects. Specific approaches and incentives concerning REDD have been under consideration through the process of the Bali Action Plan agreed by the UNFCCC Parties in 2007 (COP Decision 1/CP.13). The '+' was added at the 16th COP in 2010, to expressly include the conservation, sustainable management and enhancement of forests and forest carbon stocks within the scheme's remit (Decision 1/CP.16). 207

Although REDD+ is primarily intended as a climate change mitigation toolbox, it may create so-called "co-benefits" for biodiversity conservation, including connectivity conservation. In particular, at the 16th COP, UNFCCC Parties agreed that REDD+ activities should be "consistent with the conservation of natural forests and biodiversity, ensuring that [they] are not used for the conversion of natural forests, but are instead used to incentivize the protection and conservation of natural forests and their ecosystem services," and should generally be consistent with "relevant international conventions and agreements," which obviously include the CBD and other nature conservation treaties (Decision 1/CP.16, 2010, Annex I, paras. 2(d) and 2(a)). REDD+ has the potential, to quote a CBD Technical Series volume on the issue, to serve as "an incentive to improve protected area management and provide connectivity between protected areas" (Secretariat of the Convention on Biological Diversity, 2011, p. 30). 208

1.3 Convention on Migratory Species

The Bonn Convention on the Conservation of Migratory Species of Wild Animals (CMS) (1979) aims for a "favourable conservation status" for migratory species. With regard to the endangered migratory species listed in Appendix I, Article III(4) of the Convention stipulates that CMS Parties "shall endeavour": 209

(a) to conserve and, where feasible and appropriate, restore those habitats of the species which are of importance in removing the species from danger of extinction;

(b) to prevent, remove, compensate for or minimize, as appropriate, the adverse effects of activities or obstacles that seriously impede or prevent the migration of the species; and

(c) to the extent feasible and appropriate, to prevent, reduce or control factors that are endangering or are likely to further endanger the species [..].

It is not difficult to imagine circumstances where connectivity conservation action by CMS Parties would be essential in order to meet the requirements under (a), (b) and/or (c). To illustrate, one may consider the implications of Article III(4)(b) for roads, fences, wind farms, power lines and other infrastructure which can impair connectivity in respect of migratory wildlife. Similar considerations apply to the species listed in Appendix II, which are migratory species with an unfavourable conservation status and other species which would significantly benefit from the negotiation of specific agreements. Appendix II species are to be the subject of focused ancillary instruments, which may be "AGREEMENTS" under Article IV(1)(3) or less formal "agreements" under Article IV(1)(4). Regarding AGREEMENTS, Article V of the Convention states that these should, "where appropriate and feasible," provide for: 210

[...]

(e) conservation and, where required and feasible, restoration of the habitats of importance in maintaining a favourable conservation status, and protection of such habitats from disturbances [..];

(f) maintenance of a network of suitable habitats appropriately disposed in relation to the migration routes;

(g) where it appears desirable, the provision of new habitats favourable to the migratory species [..];

(h) elimination of, to the maximum extent possible, or compensation for activities and obstacles which hinder or impede migration.

211 Several CMS ancillary instruments are discussed below in the section on regional instruments.

212 The CMS COP has acknowledged on several occasions that the objectives of the Convention cannot be achieved without ensuring adequate conservation connectivity. Various resolutions adopted by the COP in 2011 are clear in this regard. The first of these, Resolution 10.3, is specifically devoted to critical sites and ecological networks in the context of CMS. Its Preamble recognizes that "habitat destruction and fragmentation are among the primary threats to migratory species, and that the identification and conservation of habitats, in particular the critical sites and *connecting corridors*, are thus of paramount importance for the conservation of these species" (Resolution 10.3, 2011, Preamble, emphasis added).

213 Furthermore, the same Resolution amplifies this point in several respects. It recalls that "ecological connectivity can have multiple advantages, such as maintenance of viable populations and migration pathways, reduced risk of a population becoming extinct and higher resilience to climate change". It is observed that "ecological networks usually include core areas and corridors, and sometimes also restoration areas and buffer zones". It is also acknowledged that "networks of critical sites are needed in order to achieve *connectivity* and to protect migratory species along their entire migration route, and that *corridors* can occur in any habitat and should meet the requirements of the targeted species" (ibid., emphasis added). Finally, the Preamble emphasizes that "the practical approach to the identification, designation, protection and management of critical sites will vary from one taxonomic group to another or even from species to species, and that the flyway approach provides a useful framework to address habitat conservation and species protection for migratory birds along migration routes". The Preamble is explicit that such flyways qualify as "a specific type of migration corridor". A number of the operative paragraphs of Resolution 10.3 are reproduced here in full because of their considerable significance for present purposes:

(1) Requests Parties to promote the identification of the most relevant sites and corridors for migratory species, with an emphasis on those that are transboundary and would benefit from international cooperation;

(2) Invites Parties to enhance the coverage, quality and connectivity of protected areas as a contribution to the development of representative systems of protected areas and coherent ecological networks that include all taxonomic groups of migratory species;

(3) Urges Parties to undertake habitat restoration and management at protected areas and critical sites in order to ensure habitat availability during the different stages of the life cycle of migratory species;

(4) Urges Parties to explore actively the potentially suitable areas for cooperation over transboundary protected areas, ensuring that barriers to migration are to the greatest possible extent eliminated or mitigated and that migratory species are managed under commonly agreed criteria;

(6) Invites Parties to undertake concerted efforts to integrate protected areas into wider landscapes and sectors, including through the use of connectivity measures such as the development of biological corridors, where appropriate, and the restoration of degraded habitats and landscapes in order to address the impacts of and increase resilience to climate change;

(9) Encourages Parties to explore the applicability of ecological networks and corridors to marine migratory species that are under pressure from human activities such as oil and gas exploration, overexploitation, fishing and coastal development.

214 The COP also adopted a closely related resolution on flyway conservation. Resolution 10.10 requests Parties to "ensure that migratory bird habitat requirements are integrated into land-use policies, including protected areas but also especially outside protected areas" (Resolution 10.10, 2011, para.

4). Furthermore, it calls for a review of "the coverage and protection status of current site networks," and for Parties to "consider the resilience of sites to climate change, taking account of the potential for shifts in the range of species due to climate change, as well as other factors" (para. 6). In addition, Parties are requested to "ensure that key migratory stop-over sites are identified to form part of coherent site networks for migratory species," and to promote the "development of flyway-scale site networks, especially where they are least developed, to include the widest possible range of available habitat for migratory birds" (para. 7).

A third COP10 decision of particular relevance is Resolution 10.19 on climate change and migratory species. It stresses the importance of implementing Resolution 10.3 on ecological networks in the context of climate change, specifically urging Parties to "strengthen the physical and ecological connectivity between sites, permitting dispersal and colonization when species distributions shift" (Resolution 10.19, 2011, para. 8(b)). A final example from the same COP, the title of which is sufficient to illustrate its relevance for present purposes, is Resolution 10.10 on Power Lines and Migratory Birds. 215

1.4 Ramsar Convention

The Convention on Wetlands of International Importance especially as Waterfowl Habitat (Ramsar Convention) (1971) was adopted to "stem the progressive encroachment on and loss of wetlands now and in the future" (Preamble). According to Article 3(1), Parties "shall formulate and implement their planning so as to promote the conservation of the wetlands included in the List [of Wetlands of International Importance], and as far as possible the wise use of wetlands in their territory." The latter half of this obligation applies to all wetlands. The same is true of Article 4(1), which sets out an obligation to "promote the conservation of wetlands and waterfowl by establishing nature reserves on wetlands, whether they are included in the List or not." Furthermore, Parties are to consult with each other concerning the implementation of the Convention, especially with respect to transboundary wetlands (Art. 5). 216

Wetlands, such as rivers, (can) manifestly provide for connectivity. The obligations under the Convention can and do therefore contribute to connectivity conservation. (Arguably, not only conservation but also 'wise use' – which is essentially interpreted in relevant guidance as 'sustainable use' – ought to cater for sufficient degrees of conservation connectivity.) This is well acknowledged by Ramsar Convention Parties. To illustrate, a resolution on wetlands and climate change adopted by the 10th COP in 2008 affirms that the "conservation and wise use of wetlands enables organisms to adapt to climate change by providing connectivity, corridors and flyways along which they can move" (Resolution X.24, 2008, para. 12). It should be noted that wetlands on the Ramsar List are probably most likely to constitute actual or candidate core areas of protected areas networks, and to a lesser extent connecting corridors. However, a Ramsar site could theoretically extend beyond a site to a larger corridor. 217

1.5 World Heritage Convention

The Convention Concerning the Protection of the World Cultural and Natural Heritage (World Heritage Convention) (1972) applies to the natural areas that have been entered into a World Heritage List authorized under the Convention. A substantial number of ecologically important sites around the globe qualify as "natural heritage" according to the definition in Article 2 of the Convention, and some of these are included in the World Heritage List. Convention Parties are committed to doing everything within their power to ensure the "identification, protection, conservation, presentation and transmission to future generations" of the natural heritage situated on their territories (Art. 4). Moreover, to warrant that "effective and active measures" are taken for the protection of the sites concerned, Article 5 218

stipulates that each Party "shall endeavor, in so far as possible, and as appropriate for each country," to "integrate the protection of that heritage into comprehensive planning programmes" and to "take the appropriate legal, scientific, technical, administrative and financial measures necessary for the identification, protection, conservation, presentation and rehabilitation of this heritage."

219 As the case may be, it is possible to argue that this last obligation extends to connectivity measures. Indeed, the very occurrence on the World Heritage List of large wetlands like the Wadden Sea and mountain ranges such as the Canadian Rockies and the Volcanoes of Kamchatka is significant from a connectivity conservation perspective. Finally, it is noteworthy in the present context that the Operational Guidelines for the Implementation of the World Heritage Convention (WHC.08/01) instruct Parties to provide for an "adequate buffer zone" wherever this is "necessary for the proper conservation" of the site involved (para. 103). Similar to the listed Ramsar sites, as noted above, most natural sites on the World Heritage List are likely to constitute actual or candidate core areas of protected areas networks, and to a lesser extent connecting corridors unless they are covering large-scale biomes. However, the potential is there to recognise a corridor as a World Heritage Site, for example, the great wildlife migration corridors of Africa.

1.6 Other Instruments

220 Many of the instruments addressed above cover terrestrial and marine environments and species alike. Pertinent instruments with an expressly marine focus, such as the UN Convention on the Law of the Sea (1982), are dealt with in section 4 below. Also, as far as terrestrial connectivity conservation is concerned, the above review should not be considered as exhaustive. Other germane instruments with a global scope exist. One example of relevance, given the apparent linkages between connectivity and desertification (Okin et al., 2009), is the UN Convention to Combat Desertification in Those Countries Experiencing Serious Drought and/or Desertification, Particularly in Africa (1994). Another example is the UN Convention on the Law of the Non-navigational Uses of International Watercourses (1997). This convention provides a framework for watercourse agreements at the level of river basins aimed (among other things) at preserving ecosystems. Although the convention has not yet entered into force, it is regularly used as a basis for bilateral and multilateral river basin agreements.

221 Furthermore, it is appropriate to allude here to the existence of an array of relevant global instruments and arrangements that are not legally binding. The most notable among these is the UNESCO Man and the Biosphere Programme, with its biosphere reserve concept. The latter organizes areas important for conservation into three zones: a core area (which normally is a formal protected area), a buffer zone, and a transition zone (which may not be formal protected areas). The MAB biosphere reserve programme, while not governed by an international treaty, is guided by a Statutory Framework of the World Network of Biosphere Reserves (UNESCO, 1995) which has been accepted by all UNESCO member states. The Statutory Framework functions as the legal framework to guide states with the development of biosphere reserves to be designated as part of the World Network. Designations must be approved by the MAB International Coordinating Council (ICC) based on defined criteria in the Statutory Framework, and unsuitable areas may be refused.

2 International law – regional and supranational

2.1 Regional law

This section reviews a selection of international legal instruments with a regional scope which are of importance for connectivity conservation, focusing again mostly on terrestrial applications (with marine regional instruments discussed on section 4). Similar to the previous section on global instruments, it discusses pertinent treaty provisions, decisions by the Parties and other relevant guidance, bearing in mind the importance of treaty objectives and subsequent agreements and practice for the interpretation of the treaty obligations involved. It concludes with an in-depth discussion of relevant EU law. 222

2.1.1 African Convention

The African Union's major nature conservation treaty, the African Convention on the Conservation of Nature and Natural Resources, was first adopted in 1968 (Algiers Convention). It was modernized in 2003, but the revised Convention (Maputo Convention) has yet to enter into force. Both versions of the African Convention are relevant to the topic of connectivity conservation. 223

The 1968 Algiers Convention makes no express reference to connectivity. Several provisions are nonetheless of implicit relevance. According to the overarching obligation laid down in Article II, Parties "shall undertake to adopt the measures necessary to ensure conservation, utilization and development of soil, water, flora and faunal resources in accordance with scientific principles and with due regard to the best interests of the people." Clearly, the "measures necessary" will in many cases (have to) include connectivity conservation measures. Similar considerations apply to Articles VI, VIII and X. Article VI on flora requires states Parties to "adopt scientifically-based conservation, utilization and management plans of forests and rangeland, taking into account [*inter alia*] the habitat requirements of the fauna." With a view to the latter requirements, the plans referred to will, depending on the circumstances, need to make provision for corridors connecting animal and plant populations. 224

The need for connectivity conservation may likewise be read between the lines of Article VIII on protected species, in which contracting Parties "recognize that it is important and urgent to accord a special protection to those animal and plant species that are threatened with extinction, or which may become so, and to *the habitat necessary to their survival*" (emphasis added). Article X concerns "conservation areas", which term comprises several different protected area types. The provision contains a duty to "maintain and extend where appropriate [..] the Conservation areas existing at the time of entry into force of the present convention and, preferably within the framework of land use planning programmes, assess the necessity of establishing *additional conservation areas* in order to [*inter alia*] *ensure conservation of all species* and more particularly of those listed or may be listed in the annex to this convention" (emphasis added). Again, Article X can be used to support the implementation of conservation connectivity initiatives. 225

Among the many significant changes and additions incorporated in the 2003 Maputo Convention, the more comprehensive provision on "conservation areas" stands out. This provision, Article XII of the revised Convention, states: 226

> (1) The Parties shall establish, maintain and extend, as appropriate, conservation areas. They shall, preferably within the framework of environmental and natural resources policies, legislation and programmes, also assess the potential impacts and necessity of establishing additional conservation areas and wherever possible designate such areas, in order to ensure the long term conservation of biological diversity, in particular to:
>
> (a) conserve those ecosystems which are most representative of and peculiar to areas under their jurisdiction, or are characterized by a high degree of biological diversity;

(b) ensure the conservation of all species and [..] of the habitats that are critical for the survival of such species.

(2) The Parties shall seek to identify areas critically important to the goals referred to in sub paragraph 1(a) and 1(b) above which are not yet included in conservation areas, taking into consideration the work of competent international organisations in this field.

[...]

(4) The Parties shall, where necessary and if possible, control activities outside conservation areas which are detrimental to the achievement of the purpose for which the conservation areas were created, and establish for that purpose buffer zones around their borders.

227 The consistent implementation of this provision would be conducive to connectivity conservation in the region. Another provision of significance in the current context is Article XIII of the Maputo Convention, according to which Parties "shall ensure that [..] in the formulation of all development plans, full consideration is given to ecological [..] factors" (para. 1). "To this end, the Parties shall," among other things, "to the maximum extent possible, take all necessary measures to ensure that development activities and projects" – for instance the construction of roads or other infrastructure – "are based on sound environmental policies and do not have adverse effects on natural resources and the environment in general" (Art. XIII(2)(a)).

2.1.2 Bern Convention

228 The aims of the Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention) (1979) are "to conserve wild fauna and flora and their natural habitats, especially those species and habitats whose conservation requires the cooperation of several States, and to promote such cooperation," with a particular emphasis on endangered and vulnerable species, including migratory ones (Art. 1). Article 2 states a general but unconditionally phrased obligation to take "requisite measures" to "maintain the population of wild flora and fauna at, or adapt it to, a level which corresponds in particular to ecological [and other] requirements." Article 3 contains a more qualified duty to "take steps to promote national policies for the conservation of wild flora, wild fauna and natural habitats, with particular attention to endangered and vulnerable species, especially endemic ones, and endangered habitats" (para. 1). It also stipulates that each Party "undertakes, in its planning and development policies [..], to have regard to the conservation of wild flora and fauna" (Art. 3(2)). Article 4 on the protection of habitats is of particular importance from a connectivity conservation point of view:

(1) Each Contracting Party shall take appropriate and necessary legislative and administrative measures to ensure the conservation of the habitats of the wild flora and fauna species, especially those specified in Appendices I and II, and the conservation of endangered natural habitats.

(2) The Contracting Parties in their planning and development policies shall have regard to the conservation requirements of the areas protected under the preceding paragraph, so as to avoid or minimise as far as possible any deterioration of such areas.

(3) The Contracting Parties undertake to give special attention to the protection of areas that are of importance for the migratory species specified in Appendices II and III and which are appropriately situated in relation to migration routes, as wintering, staging, feeding, breeding or moulting areas.

(4) The Contracting Parties undertake to co-ordinate as appropriate their efforts for the protection of the natural habitats referred to in this article when these are situated in frontier areas.

229 The strong, result-oriented obligations Article 4(1) and Article 2, read in light of the Convention's objectives, appear to entail a duty for the Bern Convention's fifty Parties to ensure the maintenance and/

or creation of adequate conservation connectivity for different species groups (see also Trouwborst, 2011).

This conclusion is reinforced by recommendations adopted by the Standing Committee – the principal treaty body in which all Parties are represented – concerning the "Emerald Network" of Areas of Special Conservation Interest set up under the Convention (on the latter, see http://www.coe.int/t/dg4/cultureheritage/nature/econetworks/Presentation_en.asp). The importance of connectivity was recognized by the Standing Committee early on, in Recommendation No. 25 (1991) on the conservation of natural areas outside protected areas proper. Part III of the Appendix to the recommendation invites Parties to – 230

> "encourage the conservation and, where necessary, the restoration of ecological corridors in particular by taking the following measures:
>
> 1. Rights of way of roads, railways and high-voltage lines
>
> - Authorising agreements between nature conservation authorities and government or public bodies owning or responsible for such areas with a view to maintaining natural plant cover and preserving the sites of rare or endangered plant species, prohibiting or limiting the use of phytosanitary products and of fire in those areas, as well as restricting the use of machinery to the strict minimum necessary for safety reasons.
>
> - Taking measures to restore or to compensate for the loss of ecological corridors caused by the building of new roads and other constructions that prevent animals from migrating or interchanging. In these cases, the responsible authority has to safeguard such crossing routes, for example, by building special tunnels for otters and badgers, by building so-called cerviducts for deer, by closing roads during the spring migrational period for amphibians, or by any other appropriate means.
>
> 2. Watercourses
>
> - Maintaining certain watercourses or parts thereof in their natural state, and where necessary restoring them, by prohibiting the building of dams, any straightening or canalisation work and the extraction of materials from their beds, and by maintaining or restoring vegetation along their banks. Ensuring that dredging operations, when they prove essential, do not harm the integrity of the aquatic ecosystem or of the banks.
>
> - On other watercourses, limiting canalisation and straightening work to whatever is absolutely essential, providing fish passes across dams, maintaining a minimum flow in low-water periods as far as possible, limiting extraction of materials from the bed and maintaining vegetation along the banks."

Connectivity conservation is also a central element in the series of detailed recommendations issued by the Standing Committee regarding the adaptation of flora and fauna to the effects of climate change. For example, Recommendation No. 135 (2008) calls on Parties to establish "networks of interconnected protected areas (terrestrial, freshwater and marine) and intervening habitat mosaics to increase permeability and aid gene flow" (Appendix, para. II(3)(c)). Likewise, in a specific section on amphibians and reptiles, Parties are called upon to "[f]acilitate in-situ adaptation and natural range shifts by redoubling efforts to maintain or restore large intact habitats and large-scale connectivity" (ibid., para. I(13)). Another prime instance is the third paragraph of Recommendation No. 143 (2009), which proposes the following action on protected areas and connectivity generally: 231

> [...]
>
> (4) Ensure the development of a sufficiently representative and connected network of protected areas so as to allow for species dispersal and settlement in new suitable sites as a consequence of climate change. In a context of great uncertainty, such a network would constitute an insurance policy to provide protection for most endangered species and habitats. [...]

(5) Connect protected areas into functional ecological networks to allow the movement of species between them. Techniques include, as appropriate, buffer zones, stepping stones, corridors, and measures to reduce habitat fragmentation.

(6) Carry out integrated management of the wider countryside to alleviate the overall pressure on biodiversity and facilitate movement of species between conservation areas, as species dispersal is likely to be the most important mechanism of species adaptation to climate change.

2.1.3 CMS ancillary instruments

232 Various ancillary instruments adopted under the Convention on Migratory Species are, or could be, vehicles for coordinated connectivity conservation on a comparatively detailed level. A few selected examples are considered here.

233 The Agreement on the Conservation of Gorillas and their Habitats (Gorilla Agreement) (2007), which entered into force in 2009, lays down the following general duty: "Parties shall take co-ordinated measures to maintain gorillas in a favourable conservation status or to restore them to such a status" (Art. II(1)). Article III(1) supplements this with an obligation to "take measures to conserve all populations of gorilla." Article III(2) stipulates that to this end Parties shall "identify sites and habitats for gorillas occurring within their territory and ensure the protection, management, rehabilitation and restoration of these sites" (para. (b)), and "coordinate their efforts to ensure that a *network of suitable habitats* is maintained or re-established throughout the entire range of all species and sub-species, in particular where habitats extend over the area of more than one Party to this Agreement" (para. (c), emphasis added).

234 For illustrative purposes, the following example shows how connectivity forms part of the specific actions laid down in the Action Plan for each gorilla subspecies. The performance of these actions is mandatory under Article II(2) of the Gorilla Agreement. The Western Lowland Gorilla Action Plan refers to a project concerning the tri-national (Congo/Gabon/Cameroon) transborder protected area complex Dja-Odzala-Minkebe (TRIDOM), the objective of which is "to maintain the functions *and ecological connectivity* in the TRIDOM and ensure long term conservation of its protected area system" (p. 9, emphasis added). The following is one of the national actions specified for the Central African Republic (p. 19): "A corridor connecting Mbaére – Bodingué and Dzanga – Ndoki must be negotiated with logging companies." The national actions for Angola include carrying out a "[c]ensus of the Mayombe Forest in Cabinda to identify viable populations of gorillas and connectivity" (p. 23). For the Democratic Republic of Congo, the plan calls for "[c]ommon planning and integrated management for the transboundary gorilla population between Dimonika, Conkouati and the reserves *and corridors* still to create on the Bas Fleuve" (p. 25, emphasis added). One of the measures included in the Eastern Lowland Gorilla Action Plan is the maintenance of an "ecological corridor between lowland and montane populations" in the Kahuzi-Biega National Park (p. 7). Finally, the Cross River Gorilla Action Plan calls for surveys of poorly known areas, "especially within potential corridors connecting population nuclei" (p. 2), and emphasizes the importance of finding ways 'to protect the corridors connecting the sub-populations' (p. 3).

235 Another CMS ancillary treaty, the African-Eurasian Waterbirds Agreement (AEWA) (1995), covers the entire African-Eurasian flyway for migratory waterbirds. The general duty of Parties to warrant a favourable conservation status for the species involved (Art. II(1)) and the obligations regarding habitat protection (Art. III(2)(c) and (d)) employ a language very similar to the obligations under the Gorilla Agreement cited above. These are complemented with more detailed provisions on the protection of

important sites in the annexed, mandatory Action Plan (see Annex 3, para. 3). These do not, however, expressly mention connectivity. Noteworthy, however, is also the prescription that Parties "shall, as far as possible, promote high environmental standards in the planning and construction of structures to minimize their impact on populations," and "should consider steps to minimize the impact of structures already in existence where it becomes evident that they constitute a negative impact for the populations concerned" (ibid., para. 4.3.5).

In order to further the adaptation of waterbird populations to climate change, the 4th AEWA Meeting of the Parties (MOP) resolved to "designate and establish comprehensive and coherent networks of adequately managed protected sites as well as other adequately managed sites, to accommodate range-shifts and facilitate waterbirds' dispersal" (MOP Resolution 4.14, 2008, para. 4). The AEWA Technical Committee was requested to "assess whether the existing international networks of sites are sufficient for the protection of migratory waterbirds, including the projected climate change effects" and, if necessary, to indicate what complementary measures should be taken (para. 5). Moreover, Parties were urged to "provide wider habitat protection for species with dispersed breeding ranges, migration routes or winter ranges where the site conservation approach would have little effect, especially under climate change conditions" (para. 7). Some of the technical guidance which has been produced under AEWA to aid Parties in the performance of their treaty obligations is also of significance in the context of connectivity conservation. In particular, AEWA Conservation Guidelines No. 11 (2008) address "how to avoid, minimize or mitigate impact of infrastructural developments and related disturbance affecting waterbirds" and No. 12 (2008) elaborates "on measures needed to help waterbirds to adapt to climate change" (available at http://www.unep-aewa.org). 236

An example of a pertinent non-legally binding CMS instrument is the Memorandum of Understanding concerning Conservation and Restoration of the Bukhara Deer (Cervus elaphus bactrianus) (Bukhara Deer MoU) (2002). This endangered red deer subspecies is threatened by a combination of habitat destruction and degradation and poaching. The aim of the MoU is "regaining a favourable conservation status of the populations of Bukhara Deer and their habitat" (Preamble). The Memorandum commits the four signatories – Kazakhstan, Tajikistan, Turkmenistan and Uzbekistan – to "identify, conserve and, where feasible and appropriate, restore those habitats of the species that are of importance in removing the sub-species from danger of extinction" (para. 1). The accompanying Action Plan, among other things, promotes the creation of "an interstate econet (system of protected areas) which could support self-sustaining population development" of Bukhara deer (Bukhara Deer Action Plan, p. 4). 237

Finally, it is of interest to note that the CMS COP resolution on ecological networks which was discussed in the previous section, urges states "to consider the network approach in the implementation of existing CMS initiatives and instruments such as the Sahelo-Saharian Antelopes Action Plan, the Monk Seal MoU, the West African Elephant MoU, the Gorilla Agreement, the Saiga Antelope MoU, the Bukhara Deer MoU, South Andean Huemul MoU and – as is already the case – in the work on flyways" (Resolution 10.3, 2011, para. 7). 238

2.1.4 Other instruments

For reasons of space, not all regional legal instruments of relevance to connectivity conservation have been analysed above. It should be noted that many more such instruments exist. Examples include the Convention on Nature Protection and Wild Life Preservation in the Western Hemisphere (Western Hemisphere Convention) (1940); the Convention for the Conservation of the Biodiversity and the Protection of Wilderness Areas in Central America (1992); the European Landscape Convention (2000); the Alpine Convention (1991) and in particular its Protocol on the Conservation of Nature and the 239

Countryside (1994); the Carpathian Convention and its Protocol on Conservation and Sustainable Use of Biological and Landscape Diversity (2003); the Protocol on Environmental Protection to the Antarctic Treaty (1991); and a range of CMS ancillary instruments which have not been discussed here. Pertinent instruments with a marine focus are discussed in section 4 below.

240 In the area of fresh water management, the UNECE Convention on the Protection and Use of Transboundary Watercourses and International Lakes (1992) is of particular relevance. This convention has laid the groundwork for many bilateral and multilateral conventions on river basins throughout Europe as well as for the EU's Water Framework Directive (see section 2.2.6, below). As discussed in that section, river connectivity often is explicitly dealt with under these river basin instruments, such as is the case with the Rhine Convention.

241 Attention should be drawn, finally, to the existence of numerous non-legally binding instruments and initiatives, such as the Pan-European Biological and Landscape Diversity Strategy (1995) and the associated Pan-European Ecological Network (PEEN). Some of these instruments are viewed in the *IUCN Guidelines for Protected Areas Legislation* for their relevance to protected areas networks.

2.2 European Union law and connectivity

Introduction

242 This subsection highlights special legal tools important for ecological connectivity that have been developed within the EU for its Member States and how these tools are achieving connectivity conservation. The EU presents a unique legal setting. While EU law is based upon international treaties, its Member States have transferred part of their sovereignty to the institutions of the EU. That is why the EU legislature is able to set rules and regulations that may immediately and directly apply within the territory of its Member States. Domestic authorities have the obligation to implement these provisions, and citizens and NGOs may invoke them before national courts, either through the implemented provisions, or directly in case the provision of the Directive has direct effect (which, basically, is the case when a provision was not implemented and is specific enough to be applied directly). Citizens and NGOs may also lodge complaints with the European Commission against the authorities of a Member State. The Commission investigates these complaints and may decide to start an infringement procedure on the basis of such complaints. When the claims are found valid, the European Court of Justice will order the Member State to comply with the relevant EU law while imposing penalty payments or fines.

243 In the 27 European countries that together form the European Union (see Box II(2)-1), EU law dominates the domestic nature conservation law and policy. In fact, for these countries, the role of international biodiversity law is less active than the EU biodiversity law because, in general, the latter is much more strict and has more far-reaching obligations. Within EU biodiversity and sustainable use law, legal tools and approaches for connectivity conservation are relatively well developed. For this reason, it is important here to include a discussion of EU connectivity law, both for insights and for lessons that may be useful to countries and regions in other parts of the world.

244 This subsection begins with a brief review of the two main legal instruments supporting EU connectivity (the Birds and Habitats Directives) and how they are implemented to support the EU's main ecological network, the Natura 2000 network. It then turns to some of the specific elements in those directives that require or promote connectivity conservation actions. Key issues and challenges associated with translating these provisions into national law are noted. Finally, the discussion closes with a look at

two related areas of EU connectivity law, river basins and marine environments. The subsection does not cover the variety of financial instruments available to the EU to support connectivity. That topic is addressed in Section II-3.5.

Box II(2)-1: Current EU Member States (as of 2012)

Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxemburg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, United Kingdom. Nine more countries are in the process of accession: Albania, Bosnia and Herzegovina, Croatia, Former Yugoslav Republic of Macedonia, Iceland, Kosovo, Montenegro, Turkey and possibly also Serbia.

2.2.1 European ecological network: Natura 2000

The two basic legal instruments through which the EU's biodiversity is protected are the EU Birds Directive (Directive 2009/147/EC) and the Habitats Directive (Directive 92/43/EEC). These Directives together have facilitated creation of a coherent, continent-wide European ecological network, called the Natura 2000 network. The legal framework for this network includes a legally binding set of rules for all of the 27 EU Member States (Art. 3 Habitats Directive). All of these Member States have to designate, according to scientific criteria, the most important terrestrial and marine areas within their jurisdiction for the conservation of – 245

- the species of birds listed in Annex I of the Birds Directive;
- all regularly occurring migratory species of birds not listed in Annex I, particularly those occurring in wetlands;
- the more than 200 habitat types (various types of forests, wetlands, meadows, mountainous areas etc.) listed in Annex I of the Habitats Directive;
- the species of animals and plants listed in Annex II of the Habitats Directive.

Part of the success of EU biodiversity law is the fact that it is not only binding for all of the Member States, there also is an effective enforcement mechanism in place. The European Commission monitors the implementation and can bring Member States before the EU Court of Justice. When the Court finds a Member State has infringed the EU law, it will order the authorities from the State to correctly apply EU law. Large penalty payments can be imposed to persuade the State to comply with EU law. 246

By 2010, a total of 26,106 areas had been designated as Natura 2000 sites, totalling 949,910 km^2, or about 17% of the EU's terrestrial area and 21% of the EU's marine area (see http://ec.europa.eu/environment/nature/natura2000/db_gis). The overarching obligation stemming from these Directives is that Member States have to achieve a favourable conservation status for all of the species and habitat types mentioned above under a-d, within each of the nine biogeographical regions of EU territory. 247

Once designated as a Natura 2000 site, a series of legal obligations apply: 248

- For each site, EU member states have to establish necessary conservation measures to maintain, or where appropriate, restore relevant habitat types and species (Art. 4(1) Birds Directive). It has been determined that the conservation status of many habitat types and species is less than favorable. For the whole of the EU, of 40%-85% of terrestrial habitats listed in Annex I of the Habitats Directive are considered to have an unfavourable conservation status (EEA 2009), making restoration measures necessary.

- Where a site is deteriorating or where there is a threat of habitat deterioration or of significant perturbation of species, EU member states have to take appropriate steps to protect these sites (Art. 6(2) Habitats Directive). On the basis of this provision, many court proceedings have been successfully initiated against member states which did not take adequate measures, such as the famous case in which the EU Court of Justice ordered the Polish authorities to immediately suspend several road projects connected to the construction of the Via Baltica highway (*Commission v. Poland*, case no. C-193/07 R, 18 April 2007).
- Projects that potentially have a significant negative effect on a Natura 2000 site in view of the site's conservation objectives may proceed only after an assessment has shown that the site's ecological integrity will not be adversely affected (Art. 6(3) Habitats Directive). The EU Court of Justice is clear that the precautionary principle plays an important role here: where doubt remains as to the absence of adverse effects on the integrity of the site with respect to its conservation objectives, the competent authority cannot authorize the project (*Landelijke Vereniging tot Behoud van de Waddenzee v. Staatssecretaris van Landbouw*, case no. C-127/02, 7 September 2004; Verschuuren 2005).
- As a consequence, in most EU member states, the judiciary now usually tests whether an appropriate assessment has been carried out for a proposed project and, if not, is prepared to stop the project. Another consequence, especially interesting for the issue of connectivity, is the fact that mitigation measures to minimize harm to the conservation objective of a site are increasingly being designed into projects. Developers and authorities may argue that because of the mitigation measures, the overall impact of the project will not be negative. The environmental assessment has to show that this indeed will be the case. The Netherlands provides a recent example of where assessment requirements and mitigation measures will be applied on a large scale (see Box II(2)-2).
- The Habitats Directive has a derogation clause in case an environmental assessment of a project deemed of high public interest and utility reveals that it will harm the integrity of a Natura 2000 site. While the authorities will not be able to authorize the project, it may still be approved if the following criteria are met (Art. 6(4) Habitats Directive):
  - there are no alternative solutions,
  - the project must be carried out for imperative reasons of overriding public interest,
  - all necessary compensatory measures are taken to ensure that the overall Natura 2000 network is protected, and
  - the European Commission is informed of the compensatory measures.

249 These compensatory measures may include measures aimed at creating or enhancing connectivity between Natura 2000 sites or other protected areas.

Box II(2)-2: The Netherlands Markermeer-IJmeer Ecosystem

A recent example in the Netherlands where assessment requirements and mitigation measures will be applied on a huge scale is the development of the Markermeer-IJmeer shallow-lake ecosystem.

This project that combines housing, recreation, water surplus storage (to combat one of the consequences of climate change for this area: increased supply of river water), and nature conservation.

The plan entails the construction of some 60,000 houses on islands, as well as the creation of wetland habitats.

With the latter, the goal is to improve the conservation status of both of these Natura 2000 sites, not just to meet the legally-required minimum (i.e., no adverse impact on the integrity of the site), but to go beyond

that. This "ecological surplus" is anticipated to function as a buffer and enable the site to support the planned economic and social developments. This development opens the opportunity for connectivity measures to **be included in big infrastructure and other projects.**

Source: Samenwerkingsverband Markermeer-IJmeer (SMIJ), Investing in Markermeer and IJmeer, 2008, available through http://www.markermeerijmeer.nl/hometext1/outline1

2.2.2 Translating Natura 2000 into national law

As with most EU environmental legislation, the Birds and Habitats Directives provide minimum standards and criteria for Member States. This means that Member States must translate and incorporate these elements into their national laws in such a way as to achieve the goals of the Directives. They may set additional rules with a focus on national policy targets. A survey of the EU Member States shows that most Member States have national connectivity policies that go beyond the minimum criteria of the Directives. There are, however, substantial regional differences, which can be explained by the diverse natural characteristics, ranges in population density, traditions, and capacity of each Member State to promote and implement such policies. 250

There are several ways countries are trying to create more connectivity: through the policies which do not have binding requirements, as well as through legal channels, or a combination of these. Some states focus on integrating the protection of ecological networks in nature policy law, others identify biological links between areas in land-planning documents. Policies can also be implemented on different levels (national level, sub-national levels). In general, most of the countries start with spatial planning documents, and then adopt nature protection documents. The majority of western European states, however, begin with integrating the concept into legislation on nature protection and then try to ensure that those policies are taken into account in spatial planning documents (ESC UN 2007). 251

2.2.3 Connectivity guidance for the Natura 2000 network

Although the Habitats Directive is explicitly aimed at establishing a 'coherent ecological network' ensuring the "favourable conservation status" of target species and natural habitats, the above provisions aloneg may not lead to the creation of a functional ecological network. The Natura 2000 map (see the interactive map at http://natura2000.eea.europa.eu) shows that some member states have been relatively successful in using the Habitats Directive to create an ecological network, whereas others have mainly designated isolated protected areas. For this latter situation, Articles 3(3) and 10 of the Habitats Directive are particularly relevant. Article 3(3) provides that Member States shall endeavour to improve the ecological coherence of Natura 2000 by maintaining, and where appropriate developing, features of the landscape which are of major importance for wild fauna and flora, as referred to in Article 10. The latter provision invites member states, in their land-use planning and development policies, to maintain 252

and develop features of the landscape which are of major importance for wild fauna and flora as a way to improve the ecological connectivity of the Natura 2000 network. The European Commission issued a guidance document on Article 10 which aims to "help develop and implement integrated ecological connectivity-related measures" to maintain and restore connectivity and to respond to the impacts of climate change (Kettunen et al., 2007, p. 10). While not legally binding, this guidance document acknowledging that climate change adaptation requires flexibility in protected area management and this includes management for connectivity, instead of limiting management only to preservation within specific fixed locations (Kettunen et al., 2007, p. 47). It only provides recommendations to the Member States for the implementation of Article 10.

253 Because of the growing attention being paid to connectivity as part of climate change adaptation, new policy initiatives are emerging that also have potential to support connectivity. While these initiatives do not come with legally binding measures for the EU member states, they offer new tools and approaches. One of the most important ones is the so called Green Infrastructure initiative laid out in the 2011 'Biodiversity Strategy to 2020' (European Commission 2011). The Green Infrastructure initiative is aimed at enhancing permeability for migrating species and at re-connecting habitats which had been separated by intensive land use, transport routes and urban sprawl. 'Green Infrastructure' includes green urban areas, manmade bridges between these urban areas and natural areas, ecological corridors and zones where habitats merge (http://ec.europa.eu/environment/nature/ecosystems). According to the European Commission, national spatial planning and land use law are to be used to establish such Green Infrastructure projects (RIKS 2008). The main instrument that is currently being used to promote this initiative is the EU financial tool 'LIFE' (see section II-3.5). LIFE is likely to play a major role in future EU agriculture policy and such policy will need to take into account biodiversity conservation and connectivity needs.

2.2.4 Challenges for Network implementation

254 Despite the fact that many EU Member States use the Birds and Habitats Directives as a basis for far reaching connectivity policies and projects, there is some doubt as to the existence of a firm legal obligation that forces the authorities to implement the Natura 2000 connectivity practices in the EU described above. The major shortcoming of EU nature conservation law is that there do not seem to be a binding comprehensive connectivity policy . As stated above, the wording of Articles 3(3) and 10, which focus on connectivity, is not particularly strong. More and more authors, though, argue that from the combination of this provision and the other provisions of both Directives, Member States in fact are *required* to take connectivity measures (Trouwborst 2011).

255 Recent case law seems to underpin this. In a 2011 case, the EU Court of Justice found that a mining project *within* a Natura 2000 site create a barrier between two pockets of reproduction of the brown bear because of the production of noise and vibrations (*European Commission v Spain*, case no. C-404/09, 24 November 2011). Between those two pockets, there is a transit route, with a width of 10 kilometres, that is of great importance for the western population of the brown bear. The Court found that there was a risk of deterioration and closure of the corridor might have resulted in the western population being fragmented into two sub-populations and even in the species finally being divided into three populations. Hence, it concluded that the mining operations are contrary to Article 6(2) of the Habitats Directive. The Court found that there was also a breach in Article 6(2) regarding the cutting of a corridor between two subpopulations of Capercaillie, one of which being located outside the site. This is even more interesting, as it seems to indicate that this provision also protects the subpopulations located outside the site to which the site's population is connected.

Although this case does not indicate that connectivity measures *between* protected areas are required, it does show that the authorities must have an eye on populations of species outside of the protected area. Additionally, it is fixed case law of the EU Court of Justice that activities outside of a Natura 2000 site that have a negative impact on the site, fall under the scope of the Directive (*European Commission v France*, case no. C-96/98, 25 November 1999). Taking this case law into account, the conclusion cannot be other than that destroying a corridor that leads to the deterioration of a site is not allowed either. 256

More broadly, the Habitats Directive imposes an obligation on member states to ensure a "favourable conservation status" for all species of Community interest and for typical species in natural habitats of Community interest (art. 2.2). Such status can't be reached without ensuring that population "is maintaining itself on a long-term basis as a viable component of its natural habitats" (Art. 1(i). No doubt that, from a scientific point of view, connectivity is an important factor of population viability (Born, 2004, p. 163). 257

Policy documents, however, seem to be lagging behind these recent developments in case law. In its recent White Paper on adaptation, the European Commission does state that "in future it may be necessary to consider establishing a permeable landscape in order to enhance the interconnectivity of natural areas" (European Commission, 2009, p. 11), thereby seemingly acknowledging that the current Natura 2000 regime does not sufficiently establish connectivity between natural areas to allow for species migration when climatic conditions change. 258

The same idea is apparent from the recent discussions on introducing the concept of wilderness conservation. It is argued that relying on the wilderness concept would be beneficial for improving interconnectivity of protected areas to help species adapt to changing weather patterns and changing temperatures (Bastmeijer 2009). However, the White Paper only lists one concrete action with regard to the Natura 2000 regime: "draft guidelines by 2010 on dealing with the impact of climate change on the management of Natura 2000 sites" (European Commission 2009, p. 11). 259

The aforementioned 'Biodiversity Strategy 2020', which was published in a reaction to the conclusion that the 2010 target to halt the loss of biodiversity had not been met, like the White Paper, almost completely relies on existing legal instruments. The Strategy does state that spatial planning is essential to ensure better functional connectivity between ecosystems within and between Natura 2000 areas and in the wider countryside (European Commission 2011, p. 5). It does not, however, propose to set new rules to force Member States to apply spatial planning law as indicated. This would be difficult indeed, because spatial planning is not regarded as an issue on which the EU is competent, but only when deciding by unanimity (Arts. 4 and 192.2 TFEU). That is probably why the 2011 policy document suggests using the EU's financial instruments, such as the LIFE subsidy instrument, to stimulate stakeholders to create connectivity (European Commission, 2011; see also discussion in section 3.5.2, below). 260

2.2.5 Species conservation

In addition to rules on the Natura 2000 network, the Birds and Habitats Directives also contain rules on species conservation, i.e. rules on protecting individual specimens of protected species or their breeding sites, regardless of where they are (inside or outside Natura 2000 sites). These rules may be relevant for connectivity as well. Art. 12 of the Habitats Directive, for instance, obliges Member States to take the requisite measures to establish a system of strict protection for the animal species listed in Annex IV (a) in their natural range, prohibiting (among other things) deliberate disturbance of these 261

species, particularly during the period of breeding, rearing, hibernation and migration and deterioration or destruction of breeding sites or resting places. Article 12(1) of the Habitats Directive requires more than the imposition and enforcement of a number of prohibitions. According to the European Court of Justice, Article 12 "requires the Member States not only to adopt a comprehensive legislative framework but also to implement concrete and specific protection measures" (*Commission v* Ireland, case no. C-183/05, 11 January 2007). The Court also indicated that the prescribed 'system of strict protection' of Annex IV species presupposes the 'adoption of coherent and coordinated measures of a preventive nature.' Species action plans are considered to be an effective means of implementing the requirements of this provision. These active species protection requirements must be assumed to become applicable as soon as a new (or old) Appendix IV species sets foot or puts down roots in a Member State, whether on account of climate change or otherwise (Trouwborst, 2011).

2.2.6 Examples of related EU Directives

262 Two other EU directives are important to mention because of their inherent need to take into account connectivity conservation if they are to be effective. The first is the EU Water Framework Directive which approaches water management from a river basin level. The second is the EU Marine Strategy Framework Directive dealing with marine and coastal waters.

263 **EU Water Framework Directive.** Since the EU has extensive policy and law in place in the field of water management, and since waters, by nature, often are important connectivity elements, it is relevant to briefly indicate the instruments that can be used to create wet connectivity. The EU's guidance document on Article 10 of the Habitats Directive notes that the EU Water Framework Directive of 2000 ('WFD') 'provides a good opportunity to manage river basins at transnational scale' (Kettunen et al., 2007, p. 83). The goal of the WFD (Directive 2000/60/EC) is to prevent European waters and their ecosystems from (further) deterioration and to promote sustainable water use. A further goal is to soften the effects of floods and droughts. To achieve this, Member States are obliged to designate river basin districts and draw up a River Basin Management Plan (RBMP) for each district (Art. 4(1) WFD). Where necessary, basins must be designated internationally. EU Member States are to ensure coordination of the management of these international river basins together. In this respect, the WFD calls for transboundary cooperation (Art. 3(4), WFD).

264 Although the WFD does not explicitly mention obligations to implement the provisions of the Habitats Directive, it 'has been seen to provide important support to the management and monitoring of the Natura 2000 network in the future' (Kettunen et al., 2007, p. 82). Since river basins often cross borders, Member States should explore ways to use 'the framework provided by the WFD to prevent fragmentation and enhance connectivity between Member States' (Kettunen et al., 2007, p. 83). In fact, the WFD states that 'river continuity' is one of the elements that constitute a good ecological status, which is one of the basic goals that need to be achieved. Further integration between the WFD and Habitats Directive could be achieved by integrating connectivity issues into the RBMPs, as the Guidance advises. The WFD itself does not mention climate change. The EU Guidance, however, discusses climate change in relation to the WFD. Since the WFD is still in the process of being implemented, Member States are advised to "actively support capacity building in relation to the importance and value of inland water ecosystem biodiversity, including issues related to the maintenance of ecosystems services and climate change" (Kettunen et al., 2007, p. 83).

265 The WFD underlies many bilateral and or multilateral treaties among European riparian States to address necessary cooperation at river basin level. These treaties often hold connectivity elements, for

instance with the aim to remove barriers for migrating fish. For example, the 1999 Rhine Convention has among its main goals (Art. 3(1)(c) and (d):

> maintaining, improving and restoring the natural function of the waters; ensuring that flow management (…) promotes interactions between river, ground water and alluvial areas; conserving, protecting and reactivating alluvial areas as natural floodplains; conserving, improving and restoring the most natural habitats possible for wild fauna and flora in the water, on the river bed and banks and in adjacent areas, and improving living conditions for fish and restoring their free migration.

Specific programmes have been designed to achieve these goals, such as the 'Rhine 2020' programme adopted in 2001 (ICPR, 2001). Connectivity is at the core of this programme. Along the entire river, valuable habitat types are maintained, upgraded and connected. Specific measures include: 266

- preserving free flowing river sections
- restoring river dynamics
- creating a more varied design of the structure of river banks and bottom
- opening old alluvial areas to the river
- changing to more extensive agriculture in the floodplain
- removing obstacles to the migration of the river fauna
- reconnecting old river branches and torrents.

EU Marine Strategy Framework Directive. The EU Marine Strategy Framework Directive (MFSD, Directive 2008/56/EC) sets the framework for Member States to achieve 'good environmental status' for their respective marine areas by 2020. Although the MFSD does not explicitly refer to connectivity, it is clear that in fact connectivity determines 'good environmental status' (Art. 3(5), MFSD): 267

> "good environmental status" means the environmental status of marine waters where these provide ecologically diverse and dynamic oceans and seas which are clean, healthy and productive within their intrinsic conditions, and the use of the marine environment is at a level that is sustainable, thus safeguarding the potential for uses and activities by current and future generations, i.e.: (a) the structure, functions and processes of the constituent marine ecosystems, together with the associated physiographic, geographic, geological and climatic factors, allow those ecosystems to function fully and to maintain their resilience to human-induced environmental change. Marine species and habitats are protected, human-induced decline of biodiversity is prevented and diverse biological components function in balance (…).

The MFSD and the WFD partly overlap, as the scope of both includes coastal waters. Biodiversity conservation is at the core of the MFSD, and it is expected that much of the implementation of the marine strategy will take place through marine spatial planning. The MFSD explicitly links to the Birds and Habitats Directives, as marine areas form part of the Natura 2000 network as well. The protection and management of marine Natura 2000 sites must be integrated in the marine strategy under the MFSD. As such, the connectivity requirements under the Birds and Habitats Directives will apply as well to marine policy and law under the MFSD. 268

3 National Policy and Law

Introduction – generic law and policy tools

Most national legal systems contain a variety of legal tools and supporting mechanisms from which to draw for promoting and implementing connectivity conservation through national policy and law. These include legal instruments aimed at directly implementing conservation and sustainable use policies and using a variety of legal tools to do so, from direct regulation at one end to entirely voluntary conservation agreements at the other. Other instruments support voluntary conservation actions through such tools 269

as incentives, education, training, and promoting non-material values such as heritage, tradition, and environmental ethics.

270 As background to the several legal topics discussed below, it is worthwhile to briefly review the kinds of legal tools and approaches useful to support connectivity conservation. While countries' legal systems may not have all these options, almost every legal system will contain some of these legal tools. Many are particularly relevant for lands owned or controlled by non-state actors, such as individuals, communities, NGOs, or corporations. This is likely to be the case for the bulk of the important connectivity areas needing protection or restoration in many countries (see Part I, section 3 above on tenure possibilities).

271 In terms of action, it is important to stress that identifying priority connectivity areas and planning legal protection for these areas should start with the legal instruments and supporting tools a country already has available. Amending or enacting new legislation takes time and opportunities to safeguard critical sites may be lost in the interim. Conservation planning in general and for protected areas systems in particular should include planning for connectivity (as discussed in Part I, section 1.2). As development pressures continue to grow and climate change address further stresses, such planning efforts are particularly important to identify priority sites and initiate measures that can be reasonably taken now to preserve connectivity before opportunities are foreclosed by continued land use changes, fragmentation and degradation. As experience is gained, proposals for strengthening existing laws and introducing new legislation can be considered where necessary and feasible.

272 One may broadly characterize legal instruments in two dimensions: substantive laws (dealing with the *substance* of a matter), and procedural laws (rules, tools, and processes implementing the substantive laws according to its objectives). In the context of connectivity conservation, substantive laws include those laws that establish protected areas, conserve biodiversity, sustainably use natural resources (such as forests or fisheries), or establish legally binding land use plans and development controls.

273 Direct regulation to require certain action and incentives to promote certain action are the two main kinds of law and policy tools available to governments to achieve connectivity conservation on lands or with resources they do not own or control. Substantive laws commonly will employ a mix of these tools. In some situations, the purchase by government of high-value conservation land may be an option. However, this is rarely used for economic and political reasons. The main uses for regulation and incentives are briefly discussed below. Box II(3)-2 below lists several different applications that may be available.

274 **Direct regulation.** In many areas of public policy, governments need to be able to set forth obligations and place restrictions on human activities and use of land and other natural resources in order to protect public health and safety or achieve certain goals determined to be in the overriding public interest. For these purposes, a government's most direct tool is regulation.

275 Regulation is important, for example, to prevent landholders from polluting, degrading soils, or undertaking illegal logging, illegal fishing, or other illegal harvesting on land or sea areas under their ownership or control. Similarly, regulation is an appropriate tool to restrict activities associated with new development when not consistent with land use plans and conservation policy. Use of regulation for these purposes is often referred to by economists as a 'command and control' strategy. A wide spectrum of laws, from those dealing with endangered species and sustainable resource use to land use planning, development control, and EIA legislation typically use regulation as a significant tool for guiding or restricting actions on non-state land (see sections 3.1-3.3 below).

In some jurisdictions, there may be constitutional limits imposed on the use of direct regulation where it intrudes unreasonably into private property rights and, in effect, becomes equivalent to eminent domain. For example, in the United States, the 5th Amendment to the U.S. Constitution provides, in part, that "private property [shall not] be taken for public use without just compensation". This has been interpreted by federal and state courts as requiring compensation to be paid by government when restrictions on private land use go so far as to amount to a regulatory 'taking'. In practice, the courts have given great deference to legislative decisions about regulation for an overwhelming public interest (for example, public health and safety, environmental protection related to development). Just compensation has normally be interpreted as the fair market value at the time of the 'taking' of existing uses, not anticipated ones. 276

In Europe, the Protocol n° 1 to the European Convention on Human Rights (ECHR) provides that every person is entitled "*to the peaceful enjoyment of his possessions".* Deprivation of property rights is forbidden *"except in the public interest and subject to the conditions provided for by law and by the general principles of international law*". However, this provision "*shall not, in any way impair the right of a State to enforce such laws as it deems necessary to control the use of property in accordance with the general interest (…)*", leaving to Parties the possibility to regulate property rights without compensation, except when it may be assimilated to a "deprivation" of possessions. The European Court of Human Rights developed a case law rather conciliatory towards conservation regulations, based on the concept of "fair balance" between the demands of the general interest of the community and the requirements of the protection of the individual's fundamental rights (ECHR, *Zvolský and Zvolská v. the Czech Republic,* 12 November 2002). Regarding connectivity, the Court judged, for example, that the annulment, without compensation, of a planning permission on the ground that the site was in an area zoned for the further development of agriculture so as to preserve a green belt and the subsequent loss of value did not violate Article 1 of the Protocol n° 1 to ECHR (ECHR, *Pine Valley Developments Ltd and others v. Ireland,* 23 October 1991). 277

Direct regulation is likely to be most effective where the objective is to persuade landholders *not* to behave in a way harmful to the environment. It is less effective where positive action is required to address an environmental problem. However, many jurisdictions place a duty of care on landholders and this may require, through direct regulation, positive action to address fundamental issues of land management such as soil conservation, following certain grazing regimes, pollution control, fire prevention, pest control and noxious weed control. (See Box 1(3)-2 in Part I, section 3.1 above, and associated discussion on how legislation in the Australian states of Victoria and Queensland address the issue of duty of care.) Incentive tools also come into play when it comes to persuading people to act in a positive way to conserve nature. For example, a connectivity area in private or communal ownership may need active management to protect valuable biodiversity or restore certain ecosystem functions. Negotiation between the national or local authorities and landholder whereby the landholder undertakes voluntary action for this purpose could be a principal strategy. In this case, incentives in the form of financial or technical assistance will be important elements for concluding a voluntary conservation agreement. 278

Incentives for voluntary action. Rather than rely solely on direct regulation to require landholders to comply with certain conservation practices beyond , governments may employ additional law and policy tools to promote and reward voluntary conservation. A range of situations may arise. Landholders on their own may decide to take conservation measures on their lands for ethical or economic reasons. They may, for example, want to attract potential customers to economic activities on their property (for example, ecotourism). In many countries, some farmers use such eco-activities to supplement income from agriculture, while others have completely switched from traditional agriculture to eco-tourism. 279

Here, government may aid these efforts through non-financial means such as providing technical assistance and training to meet tourism safety standards, certificates or licenses approving the eco-operation, and promotional publicity.

280 An example of self-initiated voluntary conservation by landowners can be found in the Netherlands. There, farmers have voluntarily undertaken nature conservation on their property and organized themselves for this purpose into Agricultural Nature Associations. There are over 120 of these regionally organized associations. They help farmers (and other landowners) with nature conservation measures on their lands, both through transfer of knowledge and through active participation. The associations also give support to their members in applying for government incentives and subsidies.

281 Government may also actively encourage and promote voluntary conservation by landholders by offering financial incentives attached to certain conditions. This approach may be characterized as semi-voluntary. In Europe, for example, governments provide incentives (often in the form of 'subsidies') to landowners to manage their lands for biodiversity and connectivity. Since an incentive is always granted under conditions, including some form of monitoring, landowners must meet those conditions to participate. Incentives may include financial ones, for example, direct payments or tax deductions when agreed conditions are met. Sometimes payments may be linked to environmental services provided by the land (for example, watershed management to protect city water supplies) or for being a good environmental steward on the land. Sections 3.4 and 3.5 below elaborate further on the variety of incentive mechanisms that legal instruments may recognize to promote voluntary conservation actions by landholders, including actions to support connectivity conservation.

282 Commonly, strategies to promote connectivity conservation by landholders will include some mix of land use or development control regulation (for example, in relation to agricultural chemical use, clearing vegetation) coupled with financial or other incentives to achieve voluntary agreement for active management. This combined approach, sometimes called the 'carrot and stick' approach, is preferred in most cases (see Box II(3)1 for an example from the UK). While voluntary action for connectivity conservation on non-state land generally is the public policy goal, some regulatory backdrop in the form of development controls or standards normally also need to be in place to protect fundamental public interests. It would be counterproductive, for example, to leave landholders with the sole decision to destroy important natural connectivity values on their lands. Regulation can set the parameters and baseline for negotiating more detailed arrangements between the government and the landholder for active land management.

283 **Purchase.** A third legal tool available in most countries, but less used today, is for government to purchase the non-state land and bring it into public ownership. This option is rarely applied to connectivity conservation purchases because of the political and economic challenges that most governments could face, especially for large-scale areas. Moreover, if land purchase can be justified on grounds of high conservation value, the concerned site probably qualifies as a formal protected area, which would give a higher level of protection and more security for the public funds spent. Compulsory acquisition also is available in most legal systems but, again, use of this tool for conservation is increasingly unpopular and rarely used, as discussed in the *IUCN Guidelines for Protected Areas Legislation* (Lausche, 2011, p. 142).

Box II(3)-1: United Kingdom: combining regulatory and incentive approaches

The use of a 'stick and carrot' approach is illustrated by UK experience. Prior to the Countryside and Rights of Way Act 2000, protection of Sites of Special Scientific Interest relied primarily on management agreements negotiated with landholders. Direct regulation could delay the proposed potentially damaging activities for only up to four months, during which time the government agency was expected to negotiate an agreement. However, this approach did not prevent destruction and deterioration of a significant proportion of sites. As a result, amendments were enacted in 2000 allowing the agency to refuse approval indefinitely, subject to a right of appeal. This provision is backed up by significant maximum fines to the landholder for disregarding the process and going ahead with the proposed action anyway. The agency can then propose a management scheme for dealing with the need for active management, and then attempt to implement it by reaching management agreements with landholders which provide payments for conservation benefits. In the past, payments have focused on compensation rather than active stewardship, and there is still an element of this insofar as they compensate for income foregone to the extent that this is not replaced by stewardship payments. If agreement cannot be reached, the agency still has authority to issue a management notice requiring the landholder to carry out reasonable management measures (Bell and McGillivray 2008: 690-702).

Box II(3)-2 below lists several different applications of regulations, incentives and other supporting law and policy tools that may be used to require or promote connectivity conservation planning and action by government agencies, landholders, land and marine managers, and the public. Many of these tools already are available to governments in existing conservation and other law and policy instruments, and it is likely that their extension in some form to connectivity conservation already will be within the scope and objectives of some of those instruments. 284

Box II(3)-2: Diverse array of law and policy tools for connectivity conservation

There are a variety of law and policy tools available in most legal systems for advancing the stated objectives and purposes of substantive laws. Such tools may be useful in particular situations, alone or in combination, for advancing connectivity conservation objectives. These tools include:

1. **Policy statements:** official government policy statements or reports guiding development of rules, programmes, and supporting processes for specific outcomes; may be overarching policies across all sectors (for example, national integrated development strategies, sustainable development policies) as well as policies in specific areas (for example, biodiversity strategy, land use policy, environmental protection policy).
2. **Planning:** planning is an essential initial step for assessing needs and making decisions about the appropriate legal tools to use for connectivity conservation. Planning aims to achieve certain public policy goals, such as conservation goals. Specific plans could span political levels (national, subnational, local), be integrated across sectors (for example, national integrated development plans), focus on different spatial scales (national, regional, site-specific), or address specific issues across sectors or in specific sectors or scales (for example, environmental and biodiversity action plans, climate change adaptation plans, land use plans, marine spatial plans, conservation plans, etc.). Depending on the subject and purpose, plans may be advisory providing guidance, or prescriptive requiring compliance. Strategic Environmental Assessments (SEA) also may be an important tool to inform decision-making. Where feasible, planning that integrates connectivity should be a legal requirement.
3. **Regulatory instruments:**
   - Directed primarily to conservation.
   - Directed specifically at sustainable resource use.
   - Directed principally to land use planning and development control (for example, zoning, EIAs, expropriation or purchase of specific sites by government).
   - Directed principally to transportation, infrastructure, mining, energy development, etc.
   - Tools to control individual actions: permits and licenses, conditions and obligations, planning permission, environmental requirements, notifications to permit or prohibit activities, etc.
   - Environmental standards and quality objectives.
   - Legal easements (giving the easement holder the right to do something and requiring that the landholder do something).
   - Environmental impact assessments (EIA) and strategic environmental assessments (SEA).

4. **Economic instruments:**
   - positive incentives (technical assistance, subsidies, tax credits, reduced tax liability).
   - egative incentives (higher taxes, holding back technical assistance).
   - compensation (for example, for conservation practices that result in loss of economic productivity).
   - payments for environmental services (for example, maintaining healthy forest cover for watershed services such as water supply, carbon storage, biodiversity conservation).
   - stewardship payments (for applying stewardship principles to land and resources to help maintain and restore natural systems and ecological processes using an ecosystem management approach, see Part I, Box I (1)-2 above on stewardship principles.
   - market-driven tools: emissions trading regimes, habitat banking, conservation banking.
5. **Land tenure instruments** –preemptive rights, purchase, acquisition, land exchange.
6. **Public participation tools:** mechanisms for public participation in programmes and deliberations of government authorities, self-initiated public input and monitoring, participation provisions in EIAs and SEAs, etc.
7. **Tools for data collecting and monitoring/evaluation:** inventories, environmental indicators, performance measures, monitoring for specific indicator.
8. **Tools to promote voluntary conservation:** public education, training, legal recognition of voluntary agreements and land trusts, covenants running with the land and conservation easements grounded in the law; incentives for private conservation (see above), community awards or publicity for special conservation achievements and stewardship, capacity building.

3.1 National conservation and sustainable use legislation

285 Conservation and sustainable resource use law encompasses a wide range of legal topics and approaches, most of which are dependent on or must be linked to natural connectivity in some manner in order to achieve their objectives. Some laws provide specific mechanisms for connectivity while others contain requirements that make it necessary to consider and take into account connectivity conservation needs. All such laws provide important tools for connectivity.

286 The discussion below is organized along general categories of legislation. Countries may use a variety of different formal titles for the subjects covered. How a legislative mandate for connectivity conservation is integrated within specific legal systems also may vary considerably, from a self-standing instrument, to inclusion in protection or sustainable use laws, or integration into umbrella environmental legal frameworks or codes. The subjects discussed here represent major substantive areas of law to illustrate the range of tools and approaches that may be relevant for connectivity. Most country legal systems will have one or more of these tools already available in some form which can be a basis to begin to support connectivity conservation.

287 In that context, the discussion begins by emphasizing the value of overarching conservation policies and plans as a foundation for legislative action. It then turns to a review of a variety of legislative instruments with conservation and sustainable use goals and how they may be used to support connectivity conservation. This review begins by exploring opportunities with self-standing legislation. To date, there are few examples of either generic connectivity conservation legislation, or area-specific legislation (for example, creating a specific wildlife or ecological corridor). Nevertheless, this is an emerging area of law that has generated significant interest in some countries and has considerable potential for strengthening conservation elements in conjunction with land use laws and incorporating external factors such as climate change.

288 The discussion continues with the more established and traditional kinds of legal approaches most countries have grown accustomed to using for conservation. The discussion begins with protected

areas legislation, which draws heavily on the *IUCN Guidelines for Protected Areas Legislation* (Lausche, 2011). Broad-based conservation legislation (under various names such as biodiversity laws or nature conservation laws) are highlighted next. The discussion then turns to laws directed to sustainable use of resources, where forest legislation and soil legislation are offered as key examples. Wildlife conservation laws and laws protecting specific ecosystems such as wetlands are also explored. The section closes with a brief note on the critical role connectivity plays in maintaining natural water processes and environmental flows, and the corresponding need for policies and laws to protect hydrologic connectivity and the essential ecological processes it supports.

3.1.1 Conservation policies and plans

National policies and plans for biodiversity and nature conservation provide a foundation for protected areas legislation and for the associated connectivity conservation needs of protected areas and the systems or networks of which they are a part. While not legally binding in themselves, many national policies provide an enabling environment for planning and strengthening or enacting new legislation. As explained in the *Guidelines for Protected Areas Legislation*, a national policy statement that supports and makes commitments to conservation, sustainable use or, more broadly, ecologically sustainable development can be the basis for legislation and its justification for enactment. In this context, such policies also serve as a basis for incorporating connectivity conservation as a key element of the conservation legislation. 289

Connectivity conservation can be served by national strategies and plans that commit to general or specific goals relevant for biodiversity conservation, ecosystem maintenance, and protected areas. Sometimes, such strategies and plans are relatively general but their linkage to connectivity conservation can be drawn and therefore justified. 290

In some advanced programmes reflecting the latest scientific understandings, national policies and plans incorporating conservation may include explicit reference to connectivity conservation as an element for achieving the conservation outcomes. In many programmes, however, there may not yet be explicit recognition of the role of connective but it will nevertheless need to be a part of the conservation strategy to achieve stated goals. 291

There are many official sources for national policy and planning that are useful for making the case for connectivity conservation. Among the most directly relevant are policy documents laying out national conservation or environmental action plans. Umbrella policies such as national sustainable development strategies are also valuable in this regard. Multilateral treaty obligations also may require certain policy and law commitments relevant for connectivity conservation (see a review of major treaties above in Part II, sections 1 and 2). These instruments often call upon countries to prepare national plans and strategies, especially when international assistance is involved. Main examples here are national biodiversity conservation strategies and plans required under the CBD, and national climate change adaptation plans and mitigation plans required under the Climate Change Convention. 292

Finally, national policies relevant for connectivity conservation may be found in constitutional provisions. Provisions may define certain rights and responsibilities of citizens with respect to the natural environment in general. For example, the *Basic Law for the Federal Republic of Germany* provides: “Property entails obligations. Its use shall also serve the public good” (Art. 14(2)). Other constitutional provisions may focus on nature and biodiversity conservation in particular. Some may even define what will constitute a ‘general duty of care’ of citizens to nature, land management, and the environment and require citizens to follow that standard to maintain environmental integrity and prevent environmental 293

harm. (For additional information, several examples of constitutional provisions on conservation can be found in the *IUCN Guidelines for Protected Area Legislation,* Lausche, 2011*, see* Box III(1)-1, p. 117, of those Guidelines).

3.1.2 Stand-alone legal instruments

294 Examples of stand-along connectivity laws are rare, and there are no well-established principles for such laws. Nevertheless, one can draw insights and early lessons from three current efforts, each representing a different approach: 1) generic connectivity legislation, 2) site-specific connectivity legislation, and 3) use of other instruments such as agreements or MOUs.

295 **Generic connectivity legislation.** There are few examples of country efforts to enact stand-alone generic connectivity legislation. Australia and the United States provide two examples, however, where proposals for stand-alone legislation were initiated in recent years and, while not yet successful, they provide insights on the kinds of issues, ideas, and approaches currently being considered.

296 *Australia.* The Australian example is a national initiative currently underway and steadily advancing. In March 2012, a Draft National Wildlife Corridor Plan was released for consideration by the Australian Government. This Plan was approved and launched by the Minister of Environment in November 2012. Through research undertaken for this project, it appears that Australia may be the first country to officially recognize the concept of 'National Wildlife Corridors' and set out a governance structure and formal process for establishing them.

297 The final National Wildlife Corridor (NWC) Plan is a strategy to restore and manage ecological connections in the Australian landscape. It proposes to do this by setting up a network of wildlife corridors using a diversity of land tenure and land use types. The main elements of such a network are conceptualized in the illustration in Figure II(3)-1. The Plan's objectives, guiding principles, and five-point action plan for implementation are summarized in Box II(3)-3.

Box II(3)-3: Australia National Wildlife Corridors Plan – objectives, guiding principles, and five-point action plan for implementation

Plan objectives. The National Wildlife Corridors Plan identifies six primary objectives to be achieved through its efforts to support and encourage the establishment of a network of National Wildlife Corridors, as follows:

1. Protect, maintain and restore native habitats and ecosystems and their critical processes and functions.
2. Protect natural stores of carbon in native ecosystems to minimise greenhouse gas emissions.
3. Enhance the resilience of Australia's landscapes and their adaptability to climate change.
4. Support the global and national movement of animals.
5. Assist in managing and protecting Australia's iconic landscapes and indigenous and non-indigenous cultures and heritage.
6. Increase community participation in wildlife corridors and connectivity conservation.

Guiding principles. The Plan identifies the following principles underpining the Australian Government's vision for the Plan and intended to serve as a guide to retain, restore and manage connectivity and resilience in Australian landscapes, as follows:

- Building wildlife corridors across Australian landscapes is a cooperative endeavour.
- Corridors should be designed and implemented in ways that benefit local communities.
- Healthy, functioning landscapes require connectivity at a variety of scales.
- Effective corridors connect the landscape across a mosaic of land tenures and land uses without affecting property rights.

Actions to be taken for implementation. According to the National Wildlife Corridors Plan, building a national network of wildlife corridors will be implemented gradually along the lines of a five-point plan of action, as follows:

- Developing and supporting corridor initiatives;
- Establishing enduring institutional arrangements;
- promoting strategic investment in corridors;
- working with key stakeholders and supporting regional natural resource management (NRM) planning; and
- monitoring, evaluating and reporting.

Source: Australian Government, 2012, pp. 11-15, 31.

298 Three aspects of the Australian initiative are particularly interesting for purposes of this paper: first, the public process used for preparation of the plan; second, the process laid out in the final plan for establishing national corridors, and third, the substantive content of recommendations made during the plan preparation and review process that support and provide guidance for future action on legislation.

299 Plan preparation was delegated to an independent National Wildlife Corridors Plan Advisory Group, a group of experts set up for this purpose under the authority of the Minister for Sustainability, Environment, Water, Population and Communities. Once prepared by that expert group, the draft plan was widely circulated within government and to the public, and public comments were invited. The Group also conducted stakeholder consultation meetings and received public submissions, all of which were taken into account as it finalized the draft plan for submission to the Minister.

300 The final Plan sets out a process for declaring areas to be part of a network of National Wildlife Corridors. As explained in that document: "the declaration of a National Wildlife Corridor area will be administrative, for the purpose of assigning priority to and guiding investment opportunities and will not result in any additional restrictions on property rights or land uses" (Australia Government, 2012, p. 33). The Plan lays out three broad steps for nominating and declaring a corridor as part of the national network: 1) the Minister may determine a conservation theme at the beginning of each nomination round, 2) nominations will be then invited from the public and an independent National Wildlife Council will be established to undertake assessments; and 3) nominations will be assessed against published criteria developed by the Council along with supporting information made available by the Government, after which the Council will advise the Minister on suitable proposals. Illustrating the action-oriented nature of this initiative, the final Plan already introduces six of Australia's large-scale corridors to be part of the new network: Gondwana Link, The Great Eastern Ranges Initiative (of which a separate case study has been done for this project), Habitat 141°, NatureLinks, Trans-Australia Eco-Link, and Tasmanian Midlandscapes (see Australia Government, 2012, Appendix).

301 With respect to legislation, the *draft* plan recommended and gave substantive guidance on the purpose and content of a Wildlife Corridors Act to support a network of National Wildlife Corridors and many submissions supported this. During the public comment process, some landowners indicated their concern about legislation that might interfere with their property rights and, subsequently, the proposal for legislation was withdrawn from the final Plan. During the public comment period, however, experts in connectivity conservation science and management actively participated, indicating their strong support for such legislation, and offered detailed comments on important considerations with respect to purpose, content, and implementation for development of a national wildlife corridors act. Several points are worth highlighting here because they illustrate the kinds of legal issues and elements that scientists and conservation managers in Australia consider important for an effective connectivity

programme (drawn from Wildlife Corridors Act Submission on 16 April 2012, by Worboys, authorised public assess):

1) Rational for legislation to support national wildlife corridors –
   - Confirm National Wildlife Corridors as a nationally important conservation land use and gives legal status through national listings;
   - Help with national climate change adaptation with strategic corridors that can interconnect protected areas and areas of biodiversity richness to help minimize species loss from climate change;
   - Conserve ecosystem health at a landscape scale;
   - Conserve biodiversity by helping promote new community-based voluntary conservation, giving recognition to existing voluntary efforts, and encouraging continued voluntary initiatives in strategic areas that connect protected areas, biodiversity hot spots, and sites needing restoration across the continent;
   - Help fulfill international treaty obligations in such areas as biodiversity conservation, wetlands protection, and protection of migratory bird flyways.

2) Main objectives and purposes for comprehensive legislation –
   - implement national policy commitment to develop a national network of wildlife corridors with biodiversity conservation functions, respect for property rights, indigenous landowners, and traditional state and territory responsibilities, based on voluntary participation and government as facilitator;
   - provide authority and obligation to develop design principles to guide development of corridor networks based on key ecosystem functions, biodiversity targets and conservation needs on a continent-wide basis, including for climate change adaptation and mitigation; to implement international commitments; and to achieve broader community involvement in corridor management;
   - set out possible criteria for listing a national wildlife corridor as part of the network, taking into account ways to promote and achieve strategic connectivity conservation, environmental integrity, community involvement and corridor management, and benefits for people.

3) Guidance on technical content of such legislation –
   - identify government role as facilitator;
   - emphasise voluntary nature of participation and implementation;
   - provide that the legislation will function within the existing framework of federal/state laws;
   - provide authority to recognize nationally significant corridors as 'National Wildlife Corridors' (MWCs) and create a national network of wildlife corridors;
   - establish a National Wildlife Corridors Council to oversee act's functions;
   - lay out a process for formally listing MWCs;
   - provide for a formal public nomination and assessment process;
   - provide for annual reporting to Parliament.

302 *United States*. The United States example is the 'Wildlife Corridors Conservation Act', a bill before the United States Congress in 2010 (H.R. 5101, 111th Congress, 2d Session, April 21, 2010). Motivated by the need to expand the science and stewardship of important wildlife corridors as part of preserving

America's natural environment, a main goal is to "maintain habitat connectivity and migration corridors for fish and wildlife in response to the effects of climate change and other landscape level impacts on these critical resources" (press release, April 21, 2010). The initiative had broad support from federal and state agencies, non-profit organisations and the private sector.

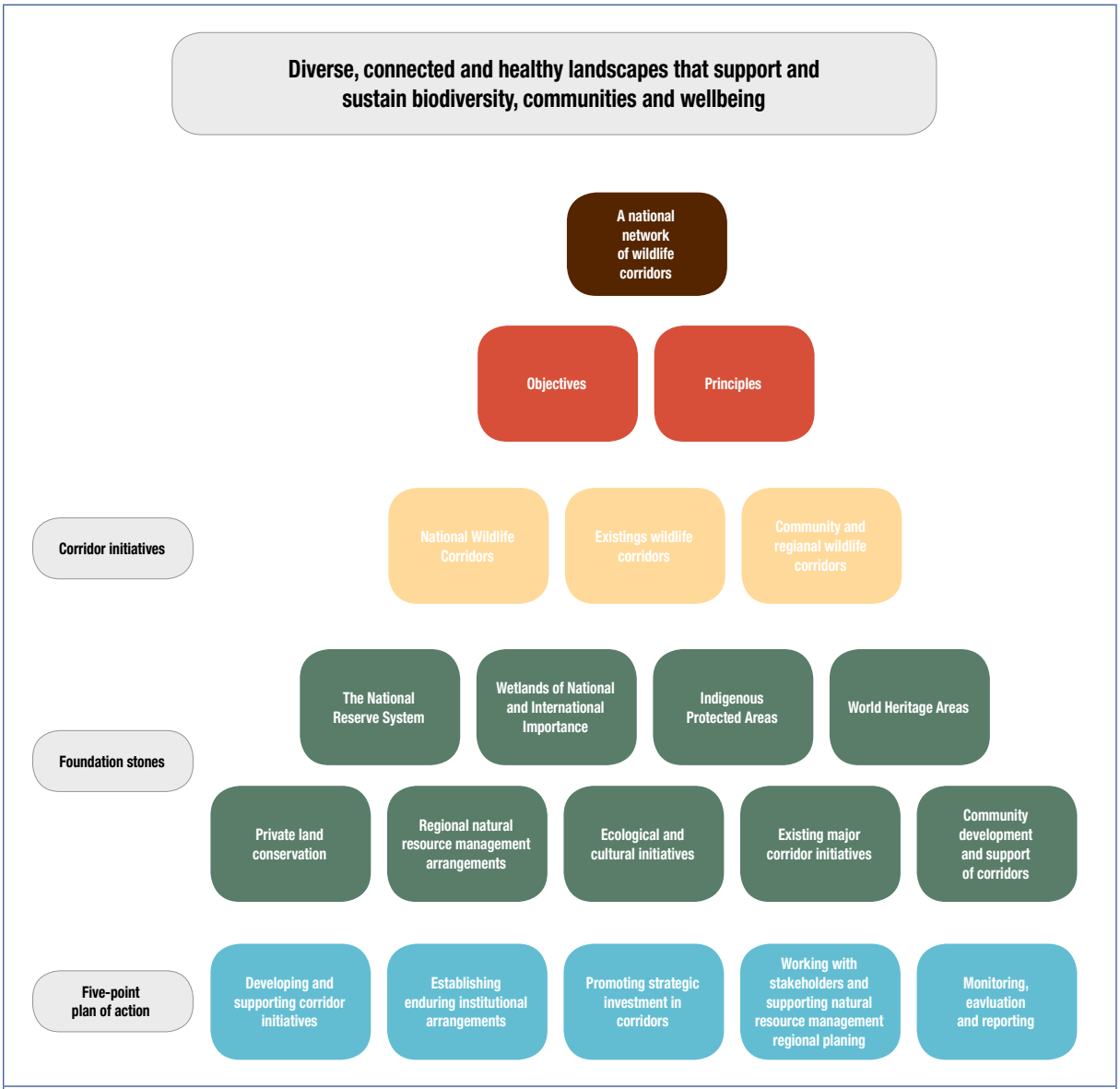
The bill identified a lead federal agency, the U.S. Fish and Wildlife Service within the Department (Ministry) of the Interior. It specified three important elements concerning the legislation's relation to other laws within the federal system. It would – 303

- operate within existing federal and state laws on conservation and environmental protection, and not override them; 304
- as needed, require amending other federal legislation to ensure that all federal land management agencies and other involved federal agencies (for example, the Department of Agriculture) conserve important wildlife corridors and include consideration of wildlife corridors in administering their conservation programs,
- fill gaps in legal capacity across sectors and jurisdictions.

The U.S. bill also enumerated several core objectives and purposes, including to – 305

- build a common data base (National Fish and Wildlife Habitat and Corridors Information program) using GIS, maps, existing descriptions, and including projected shifts in response to climate change and disseminate to the States, Indian tribes, and federal agencies;
- support States and Indian tribes in developing localized GIS data bases of fish and wildlife habitat and corridors to inform their planning and development decisions, address climate adaptation, and enhance local wildlife action plans;
- require management plans at all levels to include conservation of important wildlife corridors coordinated across sectors and jurisdictions;
- set up a Wildlife Corridors Stewardship and Protection Fund to be implemented by the National Fish and Wildlife Foundation to advance important wildlife corridor stewardship and protection projects through grants to federal agencies, states, local governments, nonprofits, and corporations.

Figure II(3)-1: Framework of elements supporting a national network of wildlife corridors



Source: Australia Government, National Wildlife Corridors Plan, 2012, p.vi (available online at http://www.environment.gov.au/biodiversity/wildlife-corridors/index.html*).*

306 **Site-specific legislation.** An innovative and successful example of a large-scale connectivity where a distinct law exists can be found in outh Korea and its Act on thr Protection of the Baekdu Daegan Mountain System (BDMS) 2003 (Act No. 7038), last amended in 2009 (Act No. 9479), available online at ECOLEX.org. This Act designates an area 0f 263,427 hectares, of which 86 per cent is made up 0f 183 protected areas existing at the time the Act entered into force, and 14 per cent consists of new buffer and core areas created to complete the corridor. the Act came into effect in 2005, creating a biodiversity corridor along the South Korea part of the Baekdu Daegan Mountain System, the main moutain range of the Korean peninsula

307 The South Korea BDMS Act provides that all protected areas within the system, whether previously existing or newe, and declared under a variety of different laws, are also subject to its authority. The Act assigns shared responsibility for implementation to two main ministries: Ministry of Environment (MoE) (responsible for 18 protected areas) and Korea Forest Service (KFS) (responsible for 144 different types of protected areas from protected forest to land-use change restricted areas). In addition, the

Ministry of Tourism, Culture and Sport, through the Cultural Heritage Administration is responsible for administering the law that applies to the 21 cultural heritage protection properties in the BDMS. The Ministry for Food, Agriculture, Forestry and Fisheries, through the KFS, has overall responsibility for the BDMS.

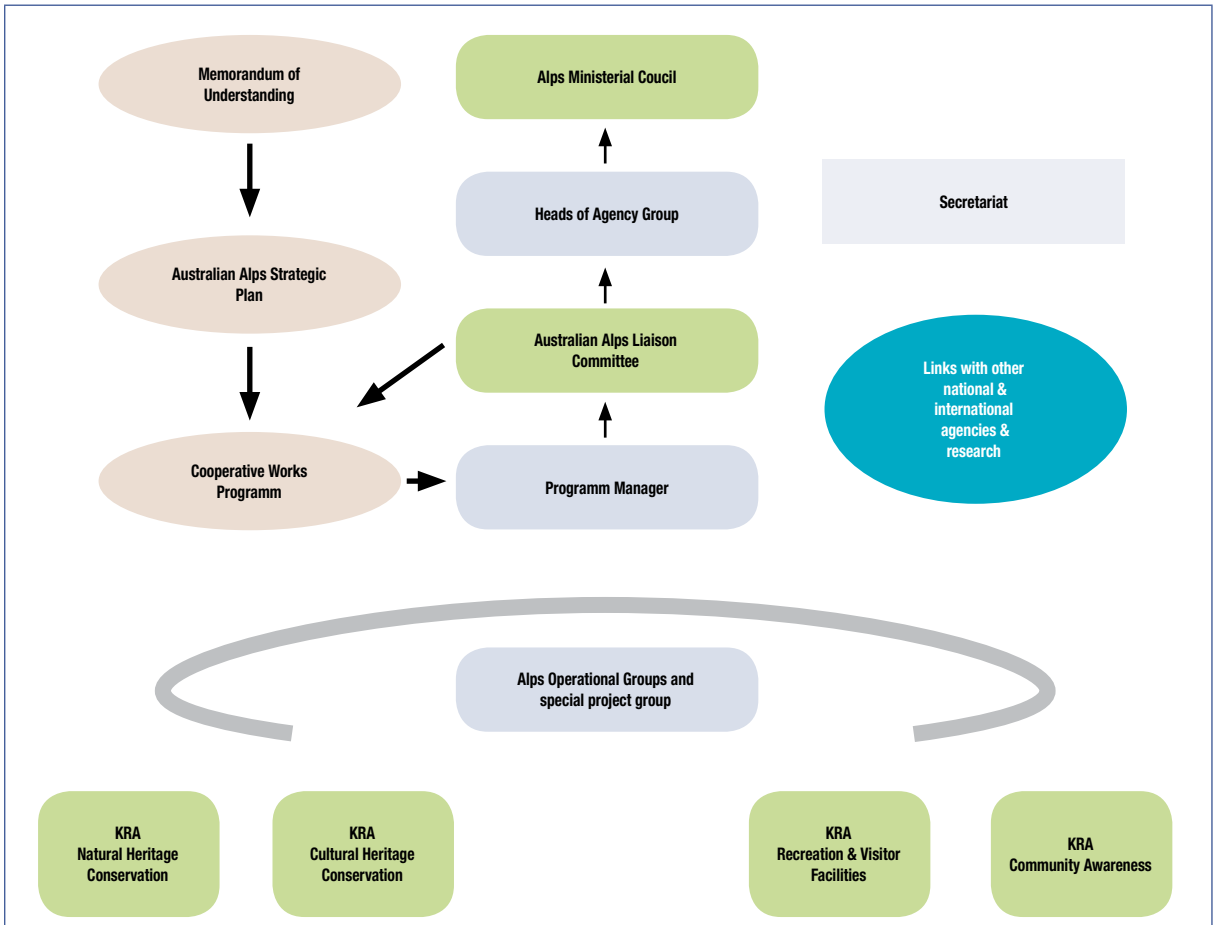
A number of general insights on legal issues and approaches can be drawn from this example, including the following: 308

- There are significant, multiple and complex legal and institutional issues to be addressed for stand-alone connectivity legislation to be effective and the development and negotiating process may take years.
- The BDMS Act builds on and retains existing protected areas and their respective legal authorities and implementing institutions.
- The MoE and the KFS are required to cooperate in establishing principles and standards for a BCMS Framework Plan, with management planning for an individual protected area to be carried out in accordance with their respective legislation so long as in compliance with the Plan.
- Except for the Plan, primary responsibility rests with KFS, in consultation with the other agencies.
- Extensive public participation is required in both the plan's formulation and implementation; over 240 consultation meetings were held with local communities, local governments, non-governmental organizations and other stakeholders.

Formal agreements. Another approach is to use official agreements and other policy-level instruments indicating commitment or intent endorsed by executive and/or legislative bodies as the basis for action. Formal agreements may set out general or specific commitment; these may be legally binding, non-binding, or partially binding depending on the agreement. 309

A Memorandum of Understanding (MoU) was used in the Australian Alps connectivity conservation initiative in the south-eastern corner of mainland Australia. This initiative stretches across a mountainous biogeographical region and contains Australia's highest peaks and unique alpine and subalpine ecosystems (Anderson and Atkins, 2010, in Worboys et al., 2010, Chapter 5). It includes national parks and other protected areas in an area that flows from Canberra in the Australian Capital Territory (ACT) and to the mountains of New South Wales (NSW) and the Victoria Alps. It involves the states of Victoria, NSW, and the ACT who are each responsible for legislation, policy and management in the connectivity area within their jurisdiction. To ensure coordination across the jurisdictions, these political entities negotiated a Memorandum of Understanding which includes a vision and multi-layered institutional and management framework at the different spatial scales (see Figure II(3)-2, below). 310

Figure II(3)-2: Australian Alps Co-operative Management Program structure and functional relationships



Source: Anderson and Atkins, 2010, in Worboys et al., 2010, p. 90

3.1.3 Protected areas legislation

311 Most countries of the world have designated protected areas with some legal basis (Lausche, 2011). A number of elements in modern legislation trigger identification of connectivity needs of protected areas and protected areas systems or networks.

312 There has been a distinct and progressive shift in science and management of protected areas over the past several decades, as discussed in Part I, from a focus on individual sites important for biodiversity (for example, high-value, representative, unique, hotspots); then to protecting individual sites as part of an ecological system or network; and now to integrating the areas and system as a whole into the broader landscape/seascape (Bonnin, 2008). This shift was reinforced by commitments of countries through international law and policy. In particular, the Convention on Biological Diversity in its Programme of Work on Protected Areas adopted by Parties to the Convention in 2004, calls on countries to integrate protected areas into broader land- and seascapes and sectors so as to maintain ecological structure and function (Goal 1.2). This is to be done by applying the ecosystem approach and taking into account ecological connectivity and the concept, where appropriate, of ecological networks (Target for Goal 1.2). The 3rd World Conservation Congress in Bangkok in 2004 reaffirmed this commitment, calling upon IUCN members, national and regional governments and civil society at

large "to develop innovative governance systems and strategic programmes fostering the integration of protected areas in their landscapes/seascapes" (WCC 3.065, Nov. 2004). As discussed in the introduction to this Part, policy has begun to make the shift to protected area networks. Law has not yet made that shift in many countries.

Drawing upon the *IUCN Guidelines for Protected Areas Legislation*, several key elements of modern protected areas legal frameworks are highlighted below for their role in connectivity conservation. An underlying principle throughout is the need for decisions about connectivity to be based on the best available scientific information on affected species, ecological processes, surrounding landscape composition and configuration for habitats, functional connectivity opportunities, shifts for climate change, and socio-economic needs. 313

Elements of protected areas legislation where connectivity could be incorporated in order to fully support biodiversity goals include the following: 314

a) **Objectives.** Whether stated in the protected areas law or an accompanying policy documents, objectives should include the general objective to establish and maintain a comprehensive, adequate, and representative system of protected areas for important terrestrial, marine and freshwater ecosystems and species. More specific objectives recognized by the international community as core principles include to promote an ecosystem approach to nature conservation by linking protected areas as ecological networks, to integrate protected areas into the broader landscape/seascape, to target specific species and ecological processes that may need special protection, and to identify and manage buffer zones and connecting linkages (corridors) to protect the connectivity needs of specific protected areas interacting with each and the system overall.

b) **Protected areas system planning.** A system plan is a strategic planning document that, among other things, guides selection and design of specific protected areas to establish a comprehensive, adequate and representative system or network of ecologically viable protected areas well integrated with other land and aquatic uses. System plans should be incorporated into and be an identified part of national conservation plans. System planning requires considering protected areas as integrated units within the broader landscape and identifying any specific connectivity needs, including buffer zones, ecological corridors, or specific patches and patterns of vegetation and habitat needing protection for specific species or processes. A system plan also should extend to connectivity needs of the protected area system or network to sustain the system and build resilient for environmental threats and environmental change, including climate changes. Legislative instruments may specifically require that protected areas system plans identify connectivity needs and gaps as part of the plan (Lausche 2011).

c) **Management plans.** Management plans for specific protected areas sites are another tool required by modern protected areas legislation which provides an opportunity and responsibility to identify connectivity needs as part of the site management plan. Normally, the purpose and general content of site management plans include identifying special management considerations, including threats from outside the area. Buffers and other connectivity links are an appropriate mechanism to be included in order to reduce identified threats, including those arising from human land use outside the reserve (pollution, habitat fragmentation), as well as invasive alien species (IAS) and climate change. Such stressors need to be taken into account in the sustainability of a site and what ecological connectivity needs it may have.

d) **Ecosystem approach.** This is a central principal guiding establishment and management of protected areas and protected areas systems, which is also required to be spelled out in protected areas legislation, necessarily takes into account ecological processes and connectivity needs across

landscapes and seascapes, and also should be a required element grounded in law for connectivity conservation.

e) **Buffer zones.** Buffer zones around protected areas serve as an immediate connectivity tool, and modern legislation for protected areas should authorize identification of necessary buffer zones around protected areas as part of the process of defining and setting out management plans for specific areas. This is normally within the scope of the authority of protected areas managers. In some jurisdictions, protected areas authorities have extensive powers also over buffer zones; in others, responsibilities may be shared or totally with another entity. The specific purpose of a buffer zone is to shield the core area from direct impacts of human activities adjacent to the area; as such they have an important role to play in connectivity conservation.

f) **Migratory species.** When a protected area or system aims specifically to protect endangered or threatened migratory or mobile species, connectivity considerations for the focal species are important to take into account in the design and management of the area; key considerations include availability and condition of critical migratory range habitats and linkages outside established protected area for mobile species to move to habitats that may be part of their natural routine.

g) **Jurisdictional issues.** At a minimum, protected areas authorities need a role in advising on land/marine uses in buffer zones and other critical connectivity areas outside the boundaries of the formal protected area; this is important because they have the expertise to advise since connectivity issues would have part of the planning process; in addition, protected area authorities are accountable for safeguarding the protected areas under their charge. Language in protected areas legislation giving protected areas managers this role necessarily brings the connectivity dimension into focus as part of protecting the purposes and objectives of the core area.

h) **Environmental impact assessment requirements.** A common element of protected areas legislation and an important tool to protect connectivity areas from proposed development activities or projects in those areas or potentially impacting such areas in ways that may degrade their connectivity conservation functions.

j) **Coordination mechanisms.** Such mechanisms should be required in protected areas legislation in order that protected areas authorities coordinate their actions across sectors and jurisdictions; coordination includes coordinating on policies, programmes and procedures across departments to ensure harmonization and avoid conflicts, collaborating on programmes, share expertise, and undertaking joint projects. Normally, a provision on coordination and consultation should be included as both a power and a duty of protected area authorities. This gives broad authority for protected areas to identify important connectivity areas and consult as needed to ensure they are protected to maintain their connectivity objectives.

i) **New governance approaches and voluntary conservation.** Modern protected areas legislation recognizes and encourages new governance approaches for protected areas management and management of conservation areas that may not qualify as formal protected areas. These approaches recognize non-government or non-state ownership or management control over areas recognized for conservation purposes, including specifically for connectivity purposes. Promoting these new governance approaches and voluntary conservation efforts results in recognizing local communities, indigenous peoples, private landowners, corporations, and other groups as central agents in promoting connectivity conservation since in most countries the bulk of the lands needing connectivity management are owned and managed by these groups.

k) **Incentive provisions for voluntary conservation.** Tax reductions, technical assistance, and other incentives (such as those discussed in section 3.5 below) are key tools for promoting voluntary conservation agreements by private landowners, communal landholders and rightsholders in sup-

port of protected areas systems. For this reason, they are important tools to recognize in protected areas legislation, and this recognition should extend to the use of such tools to support connectivity conservation actions by landholders for the benefit of particular protected areas and associated biodiversity goals.

l) **Monitoring and evaluation.** Protected areas legal frameworks should include provisions for monitoring the progress and evaluating the results of protected areas management plans and management actions in relation to defined biodiversity and other objectives. Since natural connectivity may impact the the ability to achieve those objectives, this is an aspect that should be part of the monitoring and evaluation requirement. It is important for protected areas legislation to explicitly include connectivity as a factor to be addressed in monitoring and evaluation reports. While protected areas authorities may not have authority or capacity to directly safeguard important connectivity areas outside the protected areas system, these technical reports are valuable input to broader land use planning and development controls managed by other government agencies. Such reports will identify critical connectivity conservation areas from a science perspective and the most critical conservation management needs for those areas. These findings can be the basis for negotiations with affected landholders and government agencies.

3.1.4 Biodiversity conservation laws

Some countries have enacted national biodiversity laws that apply across all landscapes or seascapes. 315
These normally are framework laws that necessarily include connectivity conservation needs for biodiversity purposes. Their geographic scope is normally nation-wide and their jurisdiction potentially covers all agencies of government in some manner. Connectivity conservation provisions contained in such laws may serve either to reinforce powers already in protected areas legislation, or more broadly to strengthen those powers with specific directives for land use planning and development control in order to protect the biodiversity linkages.

An example of a national biodiversity law is South Africa's biodiversity legislation (*National Environmental* 316
Management: Biodiversity Act, 10 of 2004, herein referred to as the Biodiversity Act). This Biodiversity Act complements and works in conjunction with the country's *National Environmental Management: Protected Areas Act* (57 of 2003) which provides the legal framework for establishing formal protected areas in the country. These two laws work together and neither is sufficient on its own for conserving important biodiversity and ecological processes in the country.

The integrated approach taken in South Africa to achieve its protected areas and biodiversity goals 317
through these two laws includes several important for supporting connectivity conservation. These include the following:

a) Scope – broad geographical and substantive scope.

b) Complementary legislation – two laws talking to each other – mutually dependant.

c) Comprehensive planning – National Biodiversity Framework, Bioregional planning and local planning (biodiversity management plans). Informs all action.

d) Integrated Planning and Alignment Across Sectors – all biodiversity plans have to feed into one another and into other planning contexts – resource use and land-use planning.

e) Listing approaches – species and ecosystems.

f) Provision for Voluntary Action – Biodiversity management plans and agreements.

g) Institutions – technical and advisory agency created – SANBI.

h) Incentives – complementary financial incentives introduced by treasury to encourage voluntary landowner action.

3.1.5 Nature conservation or nature protection laws

318 Some countries have enacted umbrella conservation laws under the label of 'nature conservation' or 'nature protection'. There may be specific reasons for preferring this terminology, perhaps because the laws were enacted before 'biodiversity conservation' as a conceptual term came into favour in the 1990s, or because reference to 'nature' rather than 'biodiversity' has more local meaning and tradition for implementation. Nature conservation laws may give special attention to special habitats and environmentally sensitive areas, or may have broad conservation goals and powers similar to laws for biodiversity conservation.

319 An example of national legislation for nature protection is Denmark's Nature Protection Act (Consolidated Act No. 749 of 21 June 2007, as amended). This act provides general protection to special habitat types or to specifically designated protection zones Protected habitat types include watercourses of a certain size, natural lakes of more than 100 square meters, and other environmental sensitive areas including heaths, bogs, humid permanent grasslands and uncultivated dry meadows. Protected zones include beaches and zones around lakes and watercourses of a certain size or width. There are also building control zones within 300 meters of forests; these are called protected forest buffers (see Lausche, 2011, p. 143).

3.1.6 Wildlife conservation laws

320 Most countries have legislation on wildlife conservation. Species legislation usually does not provide specific mechanisms for connectivity. But most will establish certain requirements in wildlife conservation that make connectivity necessary and provide the impetus for connectivity. These topics may be covered under one law or separate laws. Connectivity considerations almost always will be triggered when the species being protected is a 'flagship' species (such as large carnivores). The flagship species concept holds that by raising the profile of a particular species, it can successfully leverage more support for biodiversity conservation in general or in a particular context. The species may not be endangered, but holds a special symbolic status in the community. The rationale is that to protect the species one needs to understand the ecological requirements of the species, and thus its connectivity needs. In the Netherlands, for example, the red deer are held in high regard and to protect the species, connectivity is maintained between species populations.

321 Wildlife conservation laws may include all or some of the following three purposes: protection of endangered or threatened species, general wildlife conservation, and hunting control.These three aspects of wildlife conservation are extensively addressed in the IUCN Environmental Policy and Law Paper No. 29, *Biological Diversity Conservation and the Law: Legal Mechanisms for Conserving Species and Ecosystems* (de Klemm and Shine, 1993). Legal elements especially relevant for connectivity conservation are highlighted here.

322 **Endangered species laws.** These types of laws commonly operate using lists of specific endangered or threatened wild species that may be local, regional, migratory, or protected under international law (for example, CITES for trade, CMS for migratory species, Ramsar for international water fowl). Frequently, such lists may refer to or draw from the IUCN Red List of Threatened Species relevant for the country or region. Protections commonly include prohibitions on hunting, killing, injuring, capturing,

collecting or disturbing protected animal species and prohibitions on taking, picking, uprooting, digging up, cutting, destroying and removing specimens of wild plants.

General wildlife conservation laws. General wildlife conservation provisions may use lists to identify those species that need full or partial protection; alternatively, in some cases it may be more manageable to list unprotected species (for example, pests, weeds, rodents, non-native species or invasive alien species). Such laws may be for the purpose of partially or totally protecting certain wild plants and wild animals so that they do not become endangered or threatened. Species of plants and animals that may be protected could include those plants or animals considered to be rare and threatened with extinction if not protected, in need of protection to stabilize or replenish species of economic value, important for ecosystem processes, or of touristic, symbolic or sacred value. 323

Hunting laws. A third purpose for wildlife conservation legislation is to control hunting. Again, this is a legislative tool that may include lists of animals that may be hunted in certain seasons under specified conditions. An early motivation for hunting laws in many countries was to restrict or ban sports hunting of game species (normally limited to mammals and birds) because they were being threatened with extinction. In many developing countries, subsistence hunting also has had a long history and is beginning to require some management to avoid unsustainable hunting or reverse declining populations of subsistence animals due to uncontrolled hunting. In many countries hunting rights are with the State which then passes on the right to individuals through hunting licenses. In many other countries, especially in Europe, hunting rights belong to landowners who can lease them to hunters subject to certain conditions of safety and sustainability. Some countries have legislation which lists species classified as game and then limits the hunting of those species to declared open seasons. Where no open season has been declared, the listed game species are protected in the same way as fully protected non-game species. Finally some countries have now banned hunting of game animals totally in order to try to prevent or slow the depletion of the populations. In general, tools used by hunting legislation to protect and manage wild species include bans on hunting in certain closed areas, limits on the number of hunters, restrictions by sex or age of the animal, bag limits, hunting methods, and hunting licenses. 324

The several purposes for wildlife conservation legislation noted above provide significant tools for supporting connectivity conservation in two main respects: 325

1) they identify species to be fully or partially protected which can be a main guide for analysing which species need support with special connectivity conservation measures and when, and
2) most laws also give some protection to habitat needs of the fully or partially protected species (in order to achieve such goals such as preventing extinctions, strengthening survival and regeneration rates, and maintaining healthy populations of wild plants or animals of economic value for subsistence or sport).

In recent decades, the scope and content of wildlife conservation legislation has broadened, in part because of improved scientific understanding about the needs of wildlife and also in response to changing social values. There is growing recognition that use of any of these tools for wildlife conservation should be based on scientific findings and that conservation science should be the basis of overall wildlife policy. This has led to many laws covering not only the species and their habitat needs, but also the critical ecosystems supporting those habitats. Environmental impact assessment processes now normally must take into account negative impacts of proposed developments on protected species. Climate change adaptation considerations are adding a new dimension to wildlife conservation planning and management. These various developments underscore the importance of incorporating connectivity analysis and planning into modern wildlife conservation laws. Legal aspects 326

of wildlife legislation where connectivity analysis and management could be explicitly provided include the following:

- **Critical habitat.** Authority to designate critical habitat for endangered species, both for habitat protection and recovery, is critical. Studies have shown that the designation of critical habitat promotes species survival and recovery (Taylor et al., 2005); once this habitat is so designated it may not be disturbed.
- **Recovery plans.** Legislation should require the preparation of a species recovery plan for both domestic and migratory wild species that are threatened or vulnerable due to habitat loss or unsustainable taking; legal provisions could spell out the minimum contents of such plans (such as a description of site specific management actions and needs), require objective and measurable criteria to judge when and how well a species is recovering, identify money and resources needed to achieve recovery, require considerations of impacts from and adaptation measures for climate change, and include public participation mechanisms.
- **Projects on government lands with habitat of listed species.** If harm is likely to occur from activities of a government agency, a biological assessment could be required to be prepared by the proponent agency and reviewed by the agency responsible for wildlife conservation; where there is a scientific determination that harm is likely to occur to habitat of endangered or threatened species and no alternative exists to minimize harm, the project should not go forward unless exempted by high authority for an overriding public interest and under conditions that minimize harm.
- **Habitat conservation plans on private or community lands.** This tool, under various names, could be used where habitat of listed species is on private, community, or indigenous peoples land that is being over-hunted or proposed for development; the plan could show how development should be designed to minimize and mitigate. A development permit could be denied where endangered species habitat is clearly threatened. Habitat conservation plans could also be developed for wild species in decline as the result of unsustainable subsistence hunting and such plans could identify important habitat areas that will be protected for such animals where hunting and other harmful activities will be prohibited while the animals have a chance to replenish and stabilize.
- **Voluntary conservation agreements to improve private lands.** This tool is important to consider for wildlife conservation or related legislation in order to provide a legally-recognized means for a private, community, or indigenous landowner to take the initiative to enhance property to benefit or even attract a listed or proposed species in exchange for technical support and other incentives, including taking some specified number of individuals of the species being protected once the population is at a safe pre-determined level. (See section 3.4 below)
- **Voluntary conservation agreements to keep species from becoming endangered.** This tool is closely related to the above and could be authorized to be used with private, community or indigenous landowners to undertake measures to restore, enhance, or maintain habitat of unlisted species which are declining and have the potential to become threatened or endangered if critical habitat is not protected.

3.1.7 Sustainable resource use laws

327 Laws to secure sustainable use of natural resources are becoming increasingly common around the world. Improved scientific understanding of sustainability elements and limits for different renewable resources has helped with development of better environmental management and more sustainable production or use practices. Since the 1980s, growing international commitment to sustainable

resource use as an integral part of sustainable development also has promoted and reinforced the concept in national legislation.

At the heart of sustainable resource use is the need to maintain the diversity and interconnections of biological systems which support productive and healthy natural resources over time. Connectivity conservation is an integral part of sustainable resource use and legislation in this area provides an important opportunity to recognize and require considerations of connectivity conservation as part of resource use and management. Forest and soil resources are discussed here to illustrate the importance of connectivity for their sustainable use and elements that can provide tools for supporting connectivity. 328

Forests. Historically, forests have been among the most common landscape types for traditional linear corridors. Today, many forest areas continue to serve as linkages in some form (as biological corridors or linkages, buffer zones, or stepping stones) between protected areas (Dudley and Phillips 2006). 329

Forests are one of the most biodiversity rich habitats and cover about 30% of the Earth. They provide critical ecosystem goods and services, including food, fodder, water, shelter, nutrient cycling, and cultural and recreational value (UNCCD Information Note). Approximately 60% of all higher plant species are based in rainforests and more than 1,300 species of forest plants of medicinal or cultural value have been recorded in the Amazon basin (UNCCD, p. 3). They also present a significant global carbon stock and have a potentially significant role to play in climate change adaptation planning through maintaining ecosystem services and providing livelihood options. At the same time, they are under threat from changing climate and must themselves adapt to climate change. They are under unprecedented threat from accelerating deforestation and degradation as human populations grow, expanding consumer demand and causing more land clearing to overcome rural poverty. The need for sustainable management of the world's remaining forests has become an international issue recognized in various international declarations and statements of principle (for example, the Rio Declaration, the Forest Principles; Chapter 11 of Agenda 21, and the UN Non-Legally Binding Instrument on All Types of Forest adopted in 2007). 330

There are many types of forest throughout the world which do not meet the definition of a protected area by IUCN's guidelines but still are managed to provide socio-economic services and sustain important ecosystem functions. These include forests managed for their environmental services (for example, to reduce soil erosion and avalanches, or maintain water flow and quality), community forests (for production as well as protection), strategic reserves (if timber is needed), multiple-purpose forests (for example, managed for some native species and selective felling), recreational forests and small woodlands (for biking, picnics, outdoor sports), spiritual forests and woodlands, small woodlands for use in farming (for example, hedgerows), woodland managed for hunting, forests conserved by accident (for example, remote areas, or without timber value), ornamental gardens and arboreta, and military zones (Dudley and Phillips, 2006). Within their specified purposes, these types of forest also generally have a conservation value for species, habitat, or ecological processes, including for connectivity. 331

In most countries, many of these forest types (under a variety of names) have some formal designation through legal instruments, such as preservation orders or in some cases principal laws, for example, for soil or water conservation. Production forests for timber also commonly are governed or guided by some legal or operational standards with such matters as concession contracts for state forests, harvesting methods, and reforestation requirements. With careful planning, even production forests can be managed by standards that promote connectivity. 332

Forest areas generally are more dynamic than formal protected areas with respect to their biodiversity values because of their multiple functions for conservation, resource extraction, support to livelihoods 333

of people, and increasingly large populations (Pfund et al., 2008). Because of this, forest management and forest law has become increasingly complex involving multiple interests and cross-cutting goals, with impacts on other areas of law.

334 Modern forest legislation has an important role to play in giving legal effect to connectivity as an important function of many types of forests. In recent years, forest law has begun to respond to broader environmental objectives. A recent World Bank report identified forest law reforms for sustainable development that are receiving increased attention (Christy et al., 2007, p. 29). Three areas in particular serve to strengthen the connectivity conservation role of forests:

- **clarifying forest tenure**: tenure is now routinely seen as a critical variable in the sustainable management of forests. In much of the world, forest areas important for connectivity are owned by private persons or are owned, managed, or have land rights claims by indigenous or other local community groups. This is an area of law where forestry legislation intersects with property law. If arrangements for connectivity conservation are to be effective, tenure issues need to be considered, clarified, and given legal certainty.
- **much broader institutional reach**: forestry legislation traditionally concentrated power in a relatively stand-alone state forest administration accountable only to the minister. Today, with the multiple roles for forests, multiple stakeholders, and better technology and tools for science-based monitoring and management, it is common for forest laws to create roles for multiple institutions beyond the forest sector. Biodiversity conservation, traditional rights, integrated land-use planning and general public interest have led forest departments to expand involvement in forest decisions and other decisions affecting forest interests and concerns. This more interactive institutional setting for forest law has increased the potential for supporting and reinforcing connectivity measures in forest landscapes.
- **devolving rights and responsibilities to local level**: one of the most significant preoccupations of forest law in recent years has been with downward institutional innovation. This is part of a general trend for governments to decentralize and also to devolve rights and responsibilities to community-based groups. These trends already are raising awareness and challenges about which aspects of forest management can be delegated effectively to local governments, how supervision should be designed, what rights and responsibilities are passed to local groups and what benefit-sharing, incentives, and oversight role for government is appropriate in each case in order to balance local interests with the broader public interests in sustainable forest management, including for biodiversity and ecosystem maintenance.

335 **Soils.** Healthy soils are essential for maintaining or restoring natural connectivity in landscapes important for protected areas, biodiversity conservation, and maintenance of essential ecosystem processes. Soils are composed of both living and non-living matter with multiple interactions between them. In addition to containing important minerals and water for plants, soils filter and purify water, and are habitat for many organisms, such as earthworms, bacteria, fungi and algae. These organisms play a vital role in soil-related ecosystem services, such as nitrogen fixation, waste decomposition, water and soil mixing, and nutrient exchange and recycling.

336 When lands become degraded, the degradation of the soil is the critical component. Erosion from wind and water is one of the major contributing factors to soil degradation. Salinity, waterlogging, biological, physical, and chemical degradation are other causes. Poor farming, grazing, and forest practices, the removal of natural vegetation, over-harvesting of vegetation, and soil pollution and erosion from industry, urban development, and infrastructure are major causes of soil degradation. From the perspective of natural connectivity, degraded soils impair the capacity of land and water systems to support well-

functioning ecosystems and biodiversity conservation. This includes the ability to support connectivity conservation between protected areas.

Many countries have followed a *traditional sector approach* to the treatment of soil-related issues in their national legal frameworks. This approach has focused on addressing specific soil problems, commonly after soil erosion or degradation already has occurred due to poor land use planning or inappropriate land or water use. Individual legal responses are developed to deal with soil problems issue-by-issue, usually due to inappropriate land uses that have caused specific soil degradation issues for particular sectors, for example, agriculture, forestry, or water resource management. According to a 2002 IUCN study, these laws have generally not considered soil as an element of ecological processes with a central role in conservation of biodiversity and maintenance of essential ecosystem services. Rather, they have tended to be piecemeal and uncoordinated with no integrated oversight or overarching national policy and objectives for the sustainable use of soil (Hannam and Boer, 2002). That approaches provides little room for focusing on soils from the perspectivity of their connectivity functions and conservation needs. 337

In contrast, an *ecosystem approach* to the management of soils and to development decision making that impacts soils is being increasingly recognized as a necessary technique for taking into account the critical role of soils in natural connectivity and for protecting the ecological functions of soils for biodiversity generally, specific plant and animal populations, and people. Soil ecosystems support many essential ecological processes, from seed germination and plant protection and nutrition, to water conservation, filtration, recharge, and erosion control. Soil systems also are among the most biological diverse and abundant of any ecosystem on Earth, and support millions of species of microbes most of which are still unknown. These functions are essential for sustaining the biological and ecological connectivity needed for protected areas and biodiversity conservation, and for life on Earth. In addition, soils play a critical role in the carbon cycle and climate change. The biological component of soil is very important for capturing and storing significant amounts of carbon by photosynthesis. For these reasons, an ecosystem approach to decision making is needed in conservation and development planning to ensure the sustainable use of soils, overcome soil degradation, build ecologically sustainable agricultural and forest systems, link habitats and reduce fragmentation of landscapes and seascapes important for natural connectivity. 338

To begin to translate the science of soil ecosystems into basic legal principles, the IUCN ELP published guidelines in 2004 for drafting legislation for the sustainable use of soils (Hannam and Boer, 2004). Those guidelines identify and discuss both international principles and national considerations for strengthening existing legislation or enacting new legislation where needed. 339

Of particular interest for this concept paper, the 2004 Guidelines identify several legal elements and considerations relevant for connectivity conservation. These include: 340

- developing national soil strategies and policies that, among other things, promote the sustainable use of soil, protect the ecological functions of soil for biodiversity and for people, ensure ecologically stable and healthy soil systems, and recognize the critical role of soils in natural connectivity;
- defining the clear purpose and objectives of soil conservation and sustainable use that express the policy or strategy, including goals and general standards for the responsible institution(s);
- providing for a clear organizational structure, which may be centralized or decentralized depending on the country system, to implement, oversee, coordinate, monitor and collaborate across sectors and levels of government;

- requiring soil plans of management to incorporate natural connectivity needs between protected areas;
- providing for the specialized knowledge needed for determining needed soil protection and management measures for sustainable use of soil, including for connectivity;
- setting up enforcement and incentive mechanisms to ensure that soil standards and the role of soils in biodiversity conservation, ecosystem functions, including connectivity are supported;
- entering into soil conservation agreements with land users for specific soil conservation objectives, including connectivity;
- defining soil conservation areas covered by a soil conservation agreement to include connectivity conservation needs; requiring a soil environmental impact assessment when an activity is likely to have a significantly negative impact on the ecological and biodiversity functions of the soil, including for connectivity.

341 The Guidelines also highlight a range of instruments, from regulatory to non-regulatory tools, that may be considered when strengthening domestic legislation for sustainable use of soils. These are particularly useful tools for incorporating measures to protect and restore the natural connectivity functions of soil ecosystems as an essential component of their sustainability(see Box II(3)-4).

Box II(3)-4: Examples of legal elements for sustainable use of soils

Regulatory tools –

- Development of soil plans that prescribe legal limits and targets for soil and land use. Issuance of licenses or permits to control soil use.
- Soil use agreements between the State and individuals, which set binding soil use standards.
- The use of restraining notices where sustainable soil use limits are exceeded.
- Prosecution for failure to follow prescribed standards of sustainable soil use.

Non-regulatory tools – to be considered in legislation include authorizing and promoting:

- Education activities and awareness programs for sustainable use of soil.
- Soil ecosystem research, assessment and monitoring of soil use.
- Financial support for soil research and extension.
- Extensive use of community participatory facilities.
- Development of ecologically sustainable soil use standards and practices for self-regulation.
- Development of soil resource management, protection and incentive-based programs.

Adapted from Hannan and Boer, 2004 , p. 31.

342 **Special considerations for sustainable agriculture.** Agricultural activities represent one of the main land uses where there is potential for conflict with long-term soil conservation as well as connectivity conservation. Agricultural practices, both farming and grazing, often may disturb the spatial distribution and movement of important species.

343 Scientific understanding is improving about the connections between agriculture and biodiversity and the value that biodiversity and its services (such as pollination) provide to agriculture (Walcott, 2004). This has direct implications for the development of policies and laws for sustainable agriculture that also need to take into account the value of agricultural landscapes for biodiversity conservation and the delivery of ecosystem services.

The development of legislation specifically for sustainable agriculture provides another approach for addressing the sustainable use of soils. Here the interconnected issues of agricultural production, biodiversity conservation, and ecosystem services need to be addressed. Such legislation also provides an opportunity to take into account the natural connectivity functions of lands in agriculture. Best practices for conservation, and for improving the quality of the soil, water, and agro-ecosystems in farming activities also should recognize connectivity concepts. Some controls may be needed on ensure that agricultural practices are sustainable. These may include prohibiting overuse of fertilizers or pesticides, excessive clearing of natural vegetation, improper irrigation, poor drainage practices, degradation of watercourses and water recharge areas, or excessive soil compaction. An interesting example of agricultural legislation that incorporates soil conservation is South Africa's Conservation of Agricultural Resources Act (No. 43 of 1983) and an updated draft introduced in 2004 and still under consideration entitled, Sustainable Utilization of Agricultural Resources Bill. 344

3.1.8 Specific ecosystem or habitat-type legislation

A growing number of countries have laws to protect specific local ecosystems, habitat types, and other ecologically important areas wherever they occur. These areas typically are some of the most productive ecosystems processes and, as such, serve critical connectivity functions for many species and processes. This type of law is fairly new and the field is still evolving. The concept has grown as climate change has begun to have visible impacts on special ecosystem and habitat types through such changes as sea level rise, drought, extreme precipitation events, and temperature change. 345

Among the prominent ecosystem or habitat types addressed in specific legislation are wetlands, salt-marshes, tidal basins, mangroves, watercourses, lakes, small ponds, bogs, grasslands, old growth forests, stands of rare plants, and breeding or spawning areas for protected species. Special legislation is increasingly being used to protect those ecosystems or habitat types not already receiving adequate protection in the protected areas system. Many of these sites are owned or managed by private landowners or local communities. Regulations normally focus on minimizing harm to the ecosystem site from development, whether by government, a private landowner or local community. 346

Wetlands. This special ecosystem type is one of the most areas for legal protection. A review of some of the main legal issues and considerations arising in wetlands legislation gives insights for protecting connectivity functions. Since the 1970s, many countries have enacted legal protections for their listed wetlands, in part to comply with obligations under the Ramsar Convention (see discussion of that Convention in Section IV above). That Convention uses a broad definition of the types of wetlands covered, including lakes and rivers, swamps and marshes, wet grasslands and peat-lands, oases, estuaries, deltas and tidal flats, near-shore marine areas, mangroves and coral reefs, and human-made sites such as fish ponds, rice paddies, reservoirs, and salt pans. 347

The legal protections provided by wetland laws commonly relate to prohibitions of activities that may damage or destroy wetlands, such as filling, dredging, draining, altering, polluting, or constructing any structure. Typically, environmental impact assessments are required for proposed developments that may affect wetlands. Some countries' laws authorize issuance of permits if the proposed activity will not damage the natural system or where there is an overwhelming public interest at stake. 348

Denmark has some of the most advance legislation in the world for protecting special habitat types including all types of wetlands. Under its Nature Protection Act several habitat types are protected unless they are below a certain threshold size, and even areas that may fall below that size may still 349

be subject to protection if the total area of adjacent protected habitat exceeds the threshold (see Box II(3)-5.)

Box II(3)-5: General protection of special habitat types or zones in Denmark

Denmark's Nature Protection Act 1992, as amended, may be used to establish individual protected areas. However, in a country with little remaining natural land, the Act has a valuable role that goes much beyond this function. It includes clauses to ensure the general protection of certain habitat types and zones throughout the country. These habitat types and zones are protected in their own right, without compensation if the areas are privately owned. The specific habitat types and zones being protected are identified as follows:

Protected habitat types. The Act prohibits any activity that may alter their natural state. The exception is with a permit which may only be granted in special circumstances. The following habitat types are completely protected:

- designated watercourses (totalling approximately 30,000 km in length);
- natural lakes of more than 100 sq m;
- the following when they cover more than 2,500 sq m taken separately, jointly or in connection with lakes:
- heaths, bogs, moors, salt marches, swamps and coastal meadows;
- humid permanent grasslands and uncultivated dry meadows.

Lakes, bogs and moors are also protected in urban zones and summer cottage areas, while the other habitat types are only protected in rural zones.

Protected habitat types cover approximately 9.4 per cent of the land surface, and are registered and shown on official government maps.

Protected zones

Beaches and other stretches of coast located within 300 m of the beginning of continuous land vegetation are—

> strictly protected, in the same manner as habitat types; it is prohibited to alter their state without a permit which may only be granted in special circumstances (they cover approximately 3.5 per cent of the land surface).

Similar protection zone of 100 m around 'fixed ancient monuments' (approximately 20,000 are protected per se).

Zones of 150 m around lakes with a surface area of at least 3 hectares and along watercourses with a bottom width of no less than 2 m where, however, it is only prohibited to build, alter the surface and carry out plantation.

Protected forest buffers. There are building control zones within 300 m of forests.

From: Lausche, 2011, p. 143; Source: Consolidated Act No. 749 of 21 June 2007, as last amended by Act No. 514 of 12 June 2009.

350 A comprehensive study of national legal approaches to wetland conservation was done by the IUCN Environmental Law Programme in the late 1990s (Shine and de Klemm, 1999). Findings from that study on different approaches taken to legal protection are still relevant today in understanding options for protecting special ecosystem types for connectivity. The variables in legislative approaches included the following:

- the nature of enabling legislation – initially wetlands protections were under nature conservation legislation, more recently framework environmental legislation or modern water laws (including river basin laws) are used; modern fisheries laws also may be used (to protect aquatic vegetation habitat used by fish);
- institutional competence – in countries with a federal or decentralized structure of government, responsibility for making and/or implementing legislation may be divided between national and subnational governments or entirely delegated to the subnational level;
- range of habitat types covered – most laws in inland countries apply to lakes and marshes as a minimum and coastal countries commonly extend the definition to coastal wetlands, whether

tidal streams, mangrove forests, or estuaries; protected habitats are managed for species with no vegetation clearing or cutting of hedgerows; some laws go much further;

- minimum size of the wetlands benefiting from legal protection varies, some countries also identifying buffers around wetlands;
- ownership of wetlands subject to the legislation – permit systems linked to habitat types may be limited to privately-owned land or may apply irrespective of land ownership;
- operational effects – some laws are sufficiently detailed to provide a workable regulatory system, whilst others lay down general rules which must be implemented by means of secondary site-specific regulations. (adapted from Shine, C., and C. de Klemm 1999, p. 165)

3.1.9 Hydrologic connectivity – legal protection of environmental flows

Some countries have policies and laws to protect natural water flows and ecological processes. The water cycle, also called the hydrologic cycle, is the continuous movement of water on, above, and below the surface of the Earth. It includes groundwater, watersheds, rivers, lakes, and high-mountain catchments. In the context of natural connectivity, river systems, watersheds, and catchments provide important habitats and natural linkages for many different organisms (including endangered and threatened species) and for maintaining basic ecological processes and healthy ecosystems. River systems and water flows also are in high demand for consumptive uses (for example, hydropower generation, irrigation, drinking water, and recreation). 351

Ideally, governance regimes for hydrologic systems should extend from the watersheds and rivers out to the coastal zone and sea. (See section 4 below for a discussion of integrated coastal zone management.) Most water law regimes, however, focus hydrologic connectivity principally on freshwater systems. Creating a policy and legal framework for hydrologic connectivity of freshwater systems needs to be tailored to the needs of particular water resources and needs. As an aid in considering legal approaches, it is helpful to start with some basic concepts. In the context of freshwater management, a starting point is a connectivity concept called 'environmental flow'. Environmental flow has been defined as "the water regime provided within a river, wetland or coastal zone to maintain ecosystems and their benefits where there are competing water uses and where flows are regulated" (Dyson et al., 2003). Environmental flows form part of an ecosystem approach to integrated water resources management. The goal of sustainable environmental flows is to provide water that is adequate in terms of quantity, quality and timing for sustaining the health of the rivers, biodiversity, and other aquatic ecosystems dependent on adequate flows for their maintenance and survival. 352

An IUCN study undertaken in 2003 on environmental flows concluded that clear legal and administrative authority is needed to ensure management of water resources so that critical environmental flows for non-consumptive uses of water are available (Dyson et al., 2003). That study also found that such authority was necessary before stakeholders would commit to environmental flow requirements and agencies would fund environmental flow projects. Equally important, the study found that clear policy support was needed in order for management for environmental flows to be taken seriously. 353

A related IUCN study assessing water legal regimes in several countries also found that effective legal frameworks were fundamental to achieving water management that properly balanced the need for environmental flows for nature and connectivity with human needs and wants (sometimes called integrated water management) (Iza and Stein, 2009). The study concluded that this integrated water management approach needed to be an explicit policy. Several key messages from that study are 354

important in the context of developing legal aspects to protect connectivity of hydrologic systems and environmental flows:

- A written water policy is needed that sets out a vision and goals for environmental flows, connectivity, and integrated water resource management, explaining the need for the policy, its purpose, principles and processes for implementation and who has responsibility for carrying out the policy; connectivity should be an explicit goal of the policy;
- The national water policy, its goals, scope, principles, and purposes should be translated into national water legislation to ensure that actual water management decisions comply with the policy and to provide clear enforcement mechanisms when needed;
- A modern legal regime for water should be comprehensive and include efficiency, equity and sustainability goals, provide an institutional water management structure, protect water quality for human and ecosystem uses as defined by the water policy, address the related issues of water management for soil erosion control, promote legal certainty by consolidating inconsistent pieces of legislation, ensure public participation in water resource decision-making, and promote stewardship of water resources through training and, where feasible, environmental payments to landholders for protecting and helping to sustain natural water flows.
- Public and stakeholder support for and compliance with the water law can be enhanced using incentive mechanisms, such as taxation credits, subsidies, and payment schemes for watershed services;
- An accessible and affordable judicial system by all stakeholders and interests is key to oversight of those institutions charged with implementing the law in order to ensure that water management decisions adequately protect the necessary environmental flows for ecological purposes.

Key messages

355 A variety of legal instruments and approaches related to conservation and sustainable resource use may be available within a country's legal system to support connectivity conservation. There is no single approach. Connectivity conservation legal elements may be incorporated within an umbrella law, such as for general nature conservation or environmental protection). Alternatively, provisions may be incorporated in more issue-specific laws. Some laws may provide specific mechanisms for connectivity, such as those establishing protected areas and protected area systems and networks. Others may establish certain requirements that make connectivity a necessary consideration, such as wildlife conservation laws. Finally, enacting a distinct law on connectivity conservation or for a specific connectivity area also may be an option. This is a relatively new approach being tried in some countries especially for large-scale corridors.

356 Countries should start with law and policy tools that already exist within their legal frameworks for conservation and sustainable resource use in order to take protective measures for important connectivity areas before development pressures make conservation or restoration no longer economically or politically feasible. While it is important to aim for legal provisions that are explicit about the requirement and ecological criteria for connectivity conservation, the process of strengthening or enacting new legislation normally takes timeand considerable effort. Opportunities to use existing legal instruments to support connectivity conservation should not be delayed for that reason.

3.2 Land Use Planning Legislation

Introduction

An essential component of any connectivity conservation initiative in a terrestrial environment is advance planning of land use across the landscape to identify the appropriate boundaries of a connectivity conservation area from an ecological perspective. This section explores the potential of a particular form of legally mandated planning (variously known as land use planning, town and country planning, and in recent years 'spatial planning') to contribute towards the attainment of connectivity conservation objectives. It draws primarily on land use planning law as it is understood and practiced in developed countries, especially Europe and Australia, where there is a well-established tradition. There is much less experience with land use planning in developing countries, particularly outside urban contexts. 357

Land use planning in this sense is grounded in legislation. It is often referred to as statutory land use planning. Legislation specifies the processes for making land use plans covering specific areas of land. When they have been made, plans have legal implications for how particular sites can be developed: they are linked to a system of development control (see section 3.3 below). Land use planning in this sense assumes that the appropriate policy response is to use direct regulation to control proposed development. It does not rely on the voluntary cooperation of landholders, although it sets the back-drop within which voluntary initiatives can be pursued. Much of the detailed planning is carried out by local or regional governments, although the resulting plans must be consistent with any national plans or principles. 358

This section reviews several aspects of land use planning. It begins by outlining in general terms the assumptions and practices which have traditionally underpinned land use planning. It then highlights key issues relating to the scope of land use plans. The section then explores the relationship between land use plans and planning for conservation. It also examines the potential role of strategic environmental assessment (SEA) in developing land use plans, and issues related to the security of land use plans over the longer term. Throughout the section, the potential and limitations of land use planning to assist in the achievement of connectivity conservation objectives are highlighted. 359

3.2.1 Planning for land use and conservation

Land use plans. Land use planning does not react to specific proposals to carry out development on specific sites. It takes the initiative. Land use plans cover broad areas. Based on research into inputs such as demographic trends, infrastructure requirements and geophysical constraints, it indicates which types of changes of land use and development may be allowed in particular areas and the standards that development should meet. This tool, therefore, promises much in terms of working out the relationship between protected areas and the broader landscape, as well as balancing between productive uses and nature conservation outside of protected areas. 360

Where land use plans are made according to processes set out in legislation, they will be legally binding. Often, there will be a hierarchy of plans, at the national, regional and local level, with a requirement for plans lower in the hierarchy to be consistent with those higher (see Box II(3)-9). Plans higher in the hierarchy will set objectives and constraints that must be reflected in lower level plans. Plans at the lowest level, usually based on local government boundaries set the parameters for proposals, usually from the private sector, to carry out specific developments, including subdivisions, on specific sites. Plans may simply require compliance with subdivision, building or development standards, but they often go further and require a specific approval to be obtained from a government agency, such 361

as a local council, to carry out a development proposal and this may involve a rigorous process of assessment and modification. (See the discussion of development control in section 3.3 below).

362 A legally-binding land use plan guides development control decisions and these decisions should, as a general rule, be consistent with the plan. However, in some legal settings, for example, the UK, even proposals that conflict with the plan may be approved in some circumstances (Bell and McGillivray, 2008, pp. 404-406). To provide another example, in the Walloon Region of Belgium, proposals that conflict with land use plans may be granted subject to the obligation to justify the exceptional character of the proposal and provided that the project does "respect, structure or recompose the lines of force of the landscape (Art. 114, CWATUPE). Land use plans may take the further step of absolutely prohibiting categories of development in certain areas, for example industrial development in residential areas (England, 2011, p. 142; Farrier and Stein, 2011, p. 84; Eccles and Bryant, 2011, p. 41).

363 It is important to point out that land use planning as traditionally practiced by the planning profession is much broader than statutory land use planning (land use planning based on legislation). Planners frequently produce non-statutory plans (see discussion in Box II(3)-6 below). Indeed, the relationship between the planning profession and the law is often an uneasy one. For land use plans impose constraints not only on those proposing to carry out development, but on the planners who make, or advise in the making of, decisions under the plan. In other words, plans restrict the *discretion* exercised by planners and take away the flexibility that planners would like to have, particularly in responding to situations of rapid social change, which, for example, might create previously unpredicted demands for housing in a particular area.

Box II(3)-6: Non-legally binding plans

Land use plans may simply be statements of broad policy with limited legal consequences. These may sometimes be referred to as non-statutory plans. There is essentially a continuum of types of plan, with plans at one extreme setting a vision and spelling out broad objectives, and plans at the other extreme containing detailed, legally binding provisions about what types of development can be located in which areas.

Non-legally binding plans may be designed to form the basis of a subsequent land use plan formally made under legislative procedures. Or they may be an early step in the process of updating a plan. A constant issue faced by land use planning systems is that planners' predictions about, for example, demographic trends, are frequently proved inaccurate. In addition the community's values change. The general assumption is that plans are not fixed in time but will be responsive to these movements.

Non-legally binding plans may still be legally relevant. They cannot override prohibitions in legal plans. However, where a development is permissible, provided that a specific approval is obtained, then the courts may require decision-makers to at least take propositions in these policy documents into account in coming to a decision. This supervisory role of the courts is further discussed in section 3.3.2, below.

364 **Focus of land use plans.** It should be noted that land use planning has traditionally been concerned with the following:

- proposals to develop land rather than the current use (see below the discussion of existing uses)
- ensuring appropriate development in particular areas rather than whether development should be allowed at all
- regulating development rather than regulating to ensure that land is actively managed in an appropriate way.

365 The focus of land use planning has been on settling the broad parameters for the future development of an area rather than its conservation. Its primary concern has been with encouraging better development rather than identifying and *protecting from development* areas that are significant in terms of connectivity conservation. Public health, amenity and other constraints imposed on urban development can usually

be met by placing conditions on the type of development allowed to go ahead. Some jurisdictions, such as the UK, may even go as far as to confine land use plans to regulating the *built* development, excluding consideration of changes of land use where they do not involve buildings, for example, changes to intensified agriculture (see Box II(3)-8). Nevertheless, with necessary adjustments, land use planning systems clearly have considerable potential to play a significant role in connectivity conservation initiatives where direct regulation, rather than voluntarism is seen as an appropriate response.

Some development may be compatible with areas that play a role in connectivity conservation, for example, cultivation of organic cocoa, ecotourism, recreational opportunities and sustainable harvesting of non-timber forest products (Bennett and Mulongoy, 2006, p. 89; Moore and Shadie, 2007, p. 10). Others, such as grazing native grasslands, may be essential for conservation management. In other circumstances, however, connectivity conservation objectives may be incompatible with development. Electricity transmission lines and pipelines, for example, will create gaps in connectivity for some species. 366

Much will depend on the purpose of a connectivity conservation area. A corridor may, for example, be designed not simply to facilitate movement of an annual migration of large mammals across the landscape but also to provide habitat for particular species and an opportunity for fauna to migrate under the influence of climate change. To achieve these objectives, it may be necessary to prohibit a wide range of development. Intensive urban development will be particularly disruptive. 367

Conservation plans and policies. Conservation plans can be made for a wide range of conservation purposes. They sometimes do not have any detailed legislative basis and, where they relate to land outside protected areas, they often do not have any direct legal implications for the uses that the various landholders are currently making of their land or the development that they might carry out. In these circumstances, it is crucial that conservation plans and policies, on the one hand, and land use plans, on the other, are adequately integrated so that they do not conflict with one another. 368

At the national level, there is likely to be a broad policy statement containing general commitments to conserve biological diversity and outlining broad strategies as to how this is to be achieved (see section 3.1 of this Part, above). This will refer to the significance of protected areas, and should increasingly emphasise the importance of conservation outside of these areas. It may, for example, contain a broad commitment to connectivity conservation as a strategy for conserving biological diversity, and talk in general terms about available instruments to achieve this, such as land use plans and voluntary agreements. It may take the further step of specifying targets. For example, *Australia's Biodiversity Conservation Strategy 2010-2030*, emphasises that "[e]ffective conservation of biodiversity operates at the landscape and seascape scale across public and private tenures". Five year measurable targets have been set, including: 369

- 1,000 sq km of fragmented landscapes and aquatic systems are being restored to improve ecological connectivity
- four collaborative continental-scale linkages are established and managed to improve ecological connectivity.

Even though these broad policy statements in themselves are not legally binding, they have a valuable role in requiring government agencies at different levels, including land use planning agencies, to pursue connectivity conservation objectives and indicating the available and preferred strategies, including strategies based on law. 370

371 Conservation plans at a lower level in the hierarchy may take the further step of providing processes for identifying areas of conservation significance. The process for designating Natura 2000 sites under the EU Birds and Habitats Directive is an example of a legally binding process (see section 2.1 of this Part, above). Other jurisdictions rely on non-statutory processes. It is through these planning processes involving some version of systematic bioregional or regional conservation planning, that plans identifying the conservation significance of particular areas will be produced. It is at this point, when conservation plans become spatial, that conflicts can arise if they are not carefully integrated with land use plans. At the extremes, for example, areas identified for conservation in one plan may be zoned for development in the other. See Box II(3)-7 for an example of the careful integration of conservation and land use planning when building an ecological network in the Netherlands.

372 Conservation plans generally are made by a conservation agency (which sees its primary mission as environmental protection) and land use plans are made by a land use planning agency (which sees its primary mission as managing development). When conservation priorities directly impact the nature and extent of development projects that may be considered under a land use plan, the risk of tension between the two governmental interests is likely to be high, particularly where there are not clear criteria for assessing overall costs and benefits of different options over the long-term. This institutional situation is frequently the case. Specific conflicts and uncertainties may also arise from the fact that these two planning processes typical use different spatial measures. Conservation plans use boundaries determined by biophysical considerations (climate, lithology, geology, landforms and vegetation) which are delineated intobiogeographic regions and ecosystem types. Land use plans are likely to use historically determined administrative borders which are more aligned to political and community delineations (Slocombe, 1993, p. 291; Margerum and Born, 1995, p. 373-374).

373 Attention also needs to be paid to the analytical techniques used for developing land use plans. One such tool is land suitability assessment (LSA). This tool is widely used by land use planners as a planning approach for determining the suitability of land for a particular use. Use of this tool may not lead to agreed positions because of the different criteria used by land use planners on the one hand and conservation planners on the other (McCloskey et al., 2011). These challenges are compounded by scientific uncertainty. In addition, very different cultures may be operating in the fields of land use planning, on the one hand, and conservation management, on the other. For instance, some research suggests that the land use planning culture has been mostly based on the social sciences while the environmental management culture has its roots in the natural sciences (Cardew, 1999, p. 135).

Box II(3)-7: Netherlands Ecological Network

Land use plans may be used to set up an ecological network of core areas, buffer zones and corridors, either in a certain region or throughout the entire country. When these plans influence local rural or town plans, specific development restrictions may apply at the local level. The Netherlands ecological network is an example of this.

The designation and legal protection of the areas within the Netherlands Network is done through a mix of instruments. The core areas are protected areas under nature conservation law, mostly areas designated as Natura 2000 sites under the EU Birds and Habitats Directives (see section 2 of this Part, above), but also protected areas under purely national law. Everything outside of these protected areas is designated as being part of the Network under spatial planning law. This is done through designating areas in provincial and local zoning plans. These areas then are destined for nature conservation use only or for a combined nature conservation/agricultural use with limited agricultural activities that are not harmful to the area.

A set of requirements is laid down in local zoning plans to prevent inappropriate development within the Network, or even outside of it if the development is thought to have a negative impact on the Network. These can, for instance, prohibit the erection of buildings within the Network or set minimum distances for certain activities outside of the Network. The latter is the case for large-scale cattle breeding or other bio-industry activities emitting nitrates that have a negative impact on the quality of the natural habitats within the Network. In addition, environmental standards set through pollution control laws (either in national regulations or in individual permits) sometimes refer to the Netherlands Ecological Network by setting maximum emission levels aimed at limiting the deposition of pollutants within the Network. In essence, though, the implementation of the Netherlands Ecological Network mainly relies on the application of spatial planning law.

3.2.2 Content of plans

Urban and rural planning. In many jurisdictions, statutory land use planning has its historical roots in urban planning (see Box II(3)-8 for a UK example). Some planning legislation may not even provide for land use plans to be made for rural areas. To enable land use planning to address the issue of connectivity conservation, legislation must provide that plans are able to cover rural and urban land uses. In addition, the concept of "land use" needs to be broadly conceived so that it captures not only buildings and structures, but rural land uses, such as more intensive agricultural production methods, for example removal of hedgerows to facilitate the use of machinery. 374

Box II(3)-8: Planning in the UK

UK town planning laws emerged as a result of post-industrial urban reform. These laws had their origins in a concern to address the overcrowded and squalid conditions of burgeoning British urban centres from the late eighteenth century onwards. The focus was on public health, amenity and controlled urban growth (Grant 1982, p. 8-9). The legislation was subsequently broadened to include town *and country* planning. However this had only a limited impact in rural areas because the enabling the regulation focused only on proposals directly concerned with the *built* development, not proposals to intensify land uses without buildings. In the UK, unlike some other countries, 'development' is defined narrowly. Changes of land use which involve bringing land into agricultural production, or altering use from agriculture to forestry or forestry to agriculture, are not defined as development requiring planning permission unless they involve substantial buildings, such as battery farms (*Town and Country Planning Act* 1990 (UK), s 55(2)e; Bell and McGillivray, 2008, p. 735).

Nature conservation on private land is primarily addressed through separate legislation.

Zoning. This regulatory tool has traditionally been used in land use plans to facilitate types of development seen to be generally compatible with each other in particular areas identified spatially on a map (*zones*), and to exclude incompatible development by prohibiting it. So, for example, the plan itself may prohibit development for industrial purposes in residential zones. If prohibited development is to be carried out in a zone, the plan must first be amended by a *variance* or *spot rezoning*. Alternatively, in some jurisdictions, the plan may rely on performance standards rather than prohibitions, allowing approval to be given at the development control stage to any type of development provided that it meets certain standards (for example, no pollution). 375

376 Zoning has considerable potential for protecting areas significant for connectivity conservation from future development. Legislation should provide that specific zones or land classifications be designated for this purpose, either directly as a connectivity conservation area or, more generally, as an area needing special designation for the purposes of conservation so long as the term conservation is clearly understood to include connectivity values. (See example from New South Wales, Box II(3)-9 below). In Denmark, the *Consolidated Planning Act* (No. 883, as amended at 18 August 2004) requires corridors to be included in municipal land use plans. In South Africa, zoning schemes, prescribed under provincial planning legislation, are used to retain buffer zones around protected areas and connectivity corridors between them (Patterson, 2010: 29).

377 Where a proposed corridor traverses a range of zones identified for various kinds of development, a land use plan may provide for overlay regulation which cuts across the different zones, imposing constraints on permitted development in the interests of connectivity conservation. In the Walloon Region of Belgium, for example, land use planning legislation provides that the government may set up an 'ecological connexion perimeter' cutting across the traditional zoning in the main land use plan, allowing competent authorities to refuse a license or impose conditions in order to safeguard the interest of the perimeter for connectivity (Art. 40, 2° and 452/21 CWATUPE). However, until now, very few of these perimeters have been put in place because the plan review process is very heavy. Moreover, no scientific criteria are provided by the legislation for the selection of these perimeters, thereby jeopardizing their efficacy.

Box II(3)-9: Zoning in New South Wales, Australia

Legislation in the Australian state of New South Wales allows environment protection zones to be put in place. One of the objectives of the Environment Protection Zone in the Lord Howe Island Local Environmental Plan 2010 is to:

- protect areas that may be vulnerable to erosion or that are a habitat, or corridor, for animals that are native to the Island or significant native vegetation (cl 17).
- In this zone, most development is prohibited, but some development that threatens connectivity conservation is permissible provided that prior approval is obtained. This includes roads and electricity transmission lines.

The Albury Local Environmental Plan 2010 has an Environmental Living Zone, in which approval can be sought for residential development. However, constraints are imposed by the objectives of the zone, which are:

- to provide for low-impact residential development in areas with special ecological, scientific or aesthetic values
- to ensure that residential development does not have an adverse effect on those values
- to ensure the long term viability of populations of threatened species, populations and ecological communities by protecting and improving the condition of wildlife habitats and wildlife corridors.

378 An IUCN survey of connectivity conservation initiatives around the world concluded by advocating the use of zones in both rural and urban areas, including buffer zones, corridor zones and sustainable use zones (Moore and Shadie, 2007, p. 8-9). France provides an example of this comprehensive approach (see Box II(3)-10, below).

Box II(3)-10: Zoning in France

Land use planning in France is implemented through a hierarchy of plans: the national land use planning law, the Voynet Act 1999 (Law 99-533 of 25 June 1999); regional plans; master plans prepared by groups of associated municipalities, known as an intercommunalités; and local municipal plans, prepared by municipalities. Master plans and local municipal plans are legally binding.

The operation of this planning hierarchy to achieve connectivity conservation objectives is illustrated by the example set by the municipality of Saint-Martin d'Uriage.

This municipality is part of an intercommunalité which has a master plan requiring each local municipal plan to have a natural and wooded zone along either side of watercourses. This is reflected in the municipality's plan, which has taken the further step of establishing a subcategory within the natural and wooded zone for ecological corridors. Special rules are attached to corridors. For example, roads are prohibited where they may cause significant disturbance and those that are permitted must have border fences with diverse native plant species. Public and private fences must allow free movement of wildlife, and outdoor public and private lighting must direct beams towards the ground to minimise disturbance to wildlife (Lausche, 2011, Box III(1)-9).

379 Researchers in the Netherlands have suggested the addition of a climate change zone to the Dutch National Ecological Network and describe an exercise with ecologists carried out to delineate the zone boundaries in relation to wetlands (Vos et al., 2010). One of the adaptation measures would be to improve connectivity to facilitate range shifts. They describe this zone as:

> a focus zone for adaptation measures to enhance the adaptive capacity of the ecological network to cope with climate change and in which activities that would have a negative impact on the functioning of the ecological network, such as urbanisation or road construction, should be avoided (pp. 1467-1468).

380 **Rezoning.** Land use plans can and should be regularly reviewed and revised. There is a well-established practice in most land use planning systems for spot-rezoning *to facilitate* specific development projects in zones that are not zoned for that purpose, but the proposed project seems justified in the context of socio-economic trends and new economic development goals not yet incorporated in the plan.

381 One of the risks arising from this technique is that such spot-rezoning processes may have the effect of fragmenting important conservation connectivity areas. Alternatively, spot-rezoning also may be an important tool to protect or restore areas for conservation based on improved scientific understandings about their connectivity value, thus helping to strengthen holistic conservation planning. A scenario where challenges to existing connectivity conservation areas may arise is where there is a proposal to rezone agricultural land for residential development. Where the agricultural land also has substantial connectivity conservation value, a typical approach will be for legislation to provide that plan-makers must 'consider' or 'take into account' the provisions of existing conservation plans along with other factors. The case for conservation must be 'weighed against' considerations favouring development, and an appropriate balance sought. A different scenario may arise where a land use plan zoned a natural area for development at a time in the past when little attention was being paid to its conservation significance. Time passes and before development has actually been carried out, however, the land is identified in a conservation plan as significant for conservation. The issue here is whether the land should be rezoned so as to prevent development and restrict land use to conservation purposes. A critical element in each of these situations is for the term conservation to be clearly understood to include connectivity values so that weighing the full costs and benefits of a rezoning option takes full account of impacts on affected ecological processes, natural ecosystems, and wildlife habitat.

382 In deciding whether or not to rezone land for conservation purposes an additional consideration for the planning agency will be whether legislation requires compensation to be paid to the landholder. In some jurisdictions, compensation is payable for "injurious affection" where the development potential of land is adversely affected by a new plan (England 2011: 118-119; *Sustainable Planning Act 2009* (Q), ss 703-704). Yet even where there is no legislative requirement to pay compensation (Eccles and

Bryant 2011: 235-236), the political pressure emanating from disappointed landholder expectations, particularly residential developers who have purchased land at a premium because of the zoning, and the strength of the ideology of private property, may lead governments to maintain the status quo, or feel that they have to purchase the land if it is to be protected from development.

383 In light of this, rezoning areas currently zoned for development to areas for conservation in the light of new ecological evidence is more likely to occur only where there is strong community and political support.

3.2.3 Strategic environmental assessment of land use plans

384 Proposed and existing land use plans may be subject to a Strategic Environmental Assessment (SEA). This represents another way of integrating conservation considerations into land use planning processes.

385 In the EU, for example, the Directive on the assessment of the effects of certain plans and programmes on the environment (Directive 2001/42/EC) states that (among others) town and country planning decisions that set the framework for future development consent for projects listed in the Directive have to be made subject to an SEA.

386 In an SEA, the impact on the environment of a draft plan has to be assessed. Main infrastructure projects and large spatial developments, such as new residential areas can obviously have a major impact on connectivity as they may form massive barriers for wildlife. It is important that connectivity requirements, using the best scientific information available, are well presented and assessed in SEAs, so that they are taken into account at this level. Thus, it is essential that biodiversity experts be part of the preparation and review phases and be consulted throughout the process. At the strategic level it is easier to make drastic changes than at the development control level. Such changes may include options that avoid a certain area altogether by opting for a different route or different location. Hence the importance of this instrument for connectivity conservation.

3.2.4 Addressing existing land uses and management practices

387 Land use planning is crucial when it comes to preserving existing connectivity by protecting natural areas from fragmentation through urban or agricultural development. However, its role in restoring connectivity in fragmented landscapes is more limited. At the time a plan is made, the primary focus of land use planning has traditionally been on regulating future development rather than existing land uses and management practices, even where they are in breach of a plan's provisions (sometimes called 'nonconforming' uses). This is a particularly significant limitation in predominantly agricultural landscapes where, unlike urbanised areas, it may be feasible to modify current agricultural practices to facilitate connectivity conservation.

388 In some jurisdictions, including most Australian states, existing uses, such as existing agricultural practices, are exempted from planning regulation altogether unless the existing uses are intensified (England, 2011, p.116; Farrier and Stein, 2011, p. 163; Eccles and Bryant, 2011, p. 62). In other jurisdictions, including many civil law countries, quite limiting restrictions can be imposed on existing uses to accommodate a new plan's spatial planning goals provided compensation is paid to those landholders affected (for example, farmers). The UK takes the further step of allowing existing use rights to be removed altogether, provided that compensation is paid (Bell and McGillivray, 2008, p.

397). In practice, however, the requirement to pay compensation discourages regulation of existing uses.

To the extent that existing uses are exempted from regulation by land use plans, this places limitations on the utility of the land use planning system for achieving connectivity conservation objectives where the existing use is incompatible with these objectives. An alternative approach will be necessary, perhaps involving the use of incentives rather than direct regulation (see section II-3.5). However, it is important to remember that in some countries, the retention of traditional agricultural practices or community forestry in semi-natural habitats may be compatible with nature conservation. They may even be an essential part of conservation management. The threat is posed rather by the *intensification* of agriculture and forestry, and it may well be that this can be regulated as amounting to development (Bell and McGillivray, 2008, p. 395; Farrier and Stein, 2011, p. 166-167). 389

There are significant difficulties when it comes to deciding when an existing use ends and development begins. For example, is the removal of paddock trees or hedgerows to allow use of more efficient irrigation or harvesting technology a continuation of the existing use or does it amount to development? Should this be classified as development or simply an aspect of ordinary farm management within the prerogative of the landholder? What about the clearing of native vegetation regrowth on land that has not been cultivated for, perhaps, ten years or more? These are difficult legal questions, the answers to which depend on the precise terms of relevant legislation. 390

3.2.5 Providing for active management

Planning systems with their historical roots in the control of built development have traditionally conceived themselves as gatekeepers of development, controlling landholder demands rather than making demands of landholders. In addition, development has been seen as something that takes place at one point in time. A house is built and that is the end of the matter. The building of an industrial complex is completed and on going regulation of industrial pollution is dealt with under the pollution control system rather than the land use planning system. 391

In some jurisdictions this is changing. Landholders may be given approval for limited development of a site subject to conditions attached to the approval to actively manage the remaining land in ways that are sensitive to nature conservation. However, this is not possible where development is not simply regulated but substantially prohibited, for example as a result of a land use plan zoning land for connectivity conservation. In these circumstances, it will be much more difficult to require landholders to do more than simply respect prohibitions and to manage the land actively. The focus of land use planning legislation has been on regulating landholder expectations relating to the future development of their land. Its role has not been to insist that landholders actively manage their land (for example, for nature conservation) where this is contrary to those expectations and where landholders see little economic benefit. In these circumstances, it is likely that economic incentives in the form of stewardship payments or payments for environmental services will be needed (see discussion in section 3.5, below). 392

3.2.6 Security of plans

Secure conservation status over the long term is one of the main distinguishing features of protected areas. For an area to qualify as a protected area, the protected status should be in perpetuity, not short-term (Dudley, 2008, p. 8-9; Lausche, 2011, p. 17-19). The question is whether and, if so, how this requirement for protected area security translates to connectivity conservation areas. 393

394 There are two aspects to security of land use plans: security from what, and security for how long? The first issue has already been discussed earlier in this section. Land use plans have the potential to protect the connectivity values of particular areas from development that is inconsistent with these values. While it is true that connectivity conservation objectives will often be compatible with more intensive development than that contemplated in protected areas, development must still be configured appropriately. The land use planning system has tools, such as zoning and SEA, to deal with this.

395 In the case of protected areas, the two primary techniques for ensuring long-term security are designation by the highest possible policy making body in the particular jurisdiction, usually the legislature, and revocation only by a body of equal or higher status (Lausche, 2011, p. 17-18). The Minister in charge of protected areas is viewed as a possible alternative to the legislature "where the legal framework and standards are already defined by law".

396 In contrast, land use plans may be regularly amended through 'spot rezonings' or 'variances' to permit development. In these circumstances, the degree of security offered to a conservation zone will depend to a considerable degree on the conditions and process that must be followed to amend a plan or to deviate from it in particular cases. For most land use planning systems, this does not normally require the enactment of new legislation. It may be left to a decision at the local level, although there will usually be a process to ensure that these decisions are consistent with national and regional plans higher in the planning hierarchy. In some jurisdictions, the decision may be left to a Minister of the central government. Ministers responsible for land use planning legislation, in contrast to Ministers responsible for conservation, are likely to have a brief for development rather than conservation. The status of an area is fragile if the Minister responsible for land use planning has the legal power to spot rezone it for development over night, without public input. The greater the legal opportunities for public participation in the decision-making process, and the greater the transparency of the process, the higher the level of security.

3.2.7 Integrating land use and conservation planning

397 When it comes to making land use plans, land use planners are likely to be the ultimate decision-makers in a land use planning system that has traditionally focused on facilitating development. Conservation planners have traditionally been reduced to the role of advocates, arguing that the ecological and economic value over the long-term of continuing to conserve an area (for example, for connectivity) outweighs the more immediate socio-economic values of developing it.

398 From a connectivity conservation perspective, legislation should ideally require land use plans to be consistent with conservation plans. The argument is that where a conservation plan identifies constraints on development in the interests of connectivity conservation, this should be reflected in provisions in the land use plan restricting or even prohibiting development in these areas. This would give priority to conservation over development. This must necessarily be the position in relation to protected areas. In the Australian state of NSW, for example, there is a special national parks zone in land use plans and this simply prohibits all development in national parks except that authorised under national parks legislation. What this means is that land use plans defer to conservation plans for protected areas. This approach could be extended to require land use plans to prohibit incompatible development in areas identified for connectivity conservation by a conservation plan. Similarly, legislation could require land use plans to be consistent with the provisions of recovery plans where they identify areas of habitat necessary for the recovery of threatened species.

Another example is directly relevant to connectivity conservation: protected area legislation that allows the regulation of activities in buffer zones. Peru's *Natural Protected Areas Act* (Law 26834, Art. 25) provides that activities in identified buffer zones must not jeopardise a protected area's objectives (Solano, 2010, p. 29-30). 399

The process of bio-certifying land use plans in New South Wales, Australia, represents another attempt to give priority to conservation considerations in land use planning processes. This approach is again directly relevant to achieving connectivity conservation objectives (see Box II(3)-11, below). 400

In South Africa, systematic conservation planning is being carefully integrated with land use planning, and there is some evidence that, in practice, conservation imperatives are being given priority in land use planning processes. An recent analysis of this approach concluded: 401

> A landmark reform is that the [Western Cape's Provincial Spatial Development Framework] fully incorporates the biodiversity priorities generated by systematic conservation planning methods in the development framework, and recognizes the dependence of the built and socio-economic environments on the underlying natural resource base. Institutionally, elected local government has been empowered to apply these development principles in district and local municipalities, taking principled decision making to the most local level feasible. (Sandwith et al. 2010, p. 56-57)

Box II(3)-11: Biodiversity certification of land use plans

Biodiversity certification of plans represents one attempt to give priority to nature conservation in the land use planning process. Under 2010 amendments to the NSW *Threatened Species Conservation Act 1995*, for example, the Environment Minister may confer biodiversity certification on a particular area of land on the application of a land use planning authority such as a local council. This is conditional on the existence of a biodiversity certification strategy (a strategy for the implementation of specified conservation measures) that shows that even though development in particular areas will be allowed, the overall effect will be to *improve or maintain biodiversity values* (ss 126K, 126O). This is to be achieved by putting in place conservation measures in other areas. Conservation measures include agreements with those wishing to develop land to dedicate other land for conservation purposes, to actively manage other land to improve biodiversity values or to make a monetary contribution to improve biodiversity values elsewhere (ss 126L, 126ZH).

The result of biodiversity certification is that those subsequently seeking approval to carry out development of the land no longer have to carry out a biodiversity impact assessment at a later stage when they are seeking development approval (s 126I). The objective of biodiversity certification of land is:

> to identify and protect areas of high conservation value at an early stage in the planning process so that biodiversity impacts can be addressed and offset strategically, rather than being dealt with in a piecemeal fashion in response to individual development applications (Ogle, 2011, p. 518).

At first sight, this program may look as though priority is being given to nature conservation in the land use planning process, even though the procedure contemplates that development will be allowed. Certification cannot be given if biodiversity values are to be lost. However, the certification procedure is entirely optional and there has been little certification to date. Where land has not been certified, those seeking to carry out development can still seek approval at the development control stage provided that they comply with procedural requirements relating to biodiversity impact assessment.

Some conservation planners and managers in NSW have serious reservations about whether the Biodiversity Certification Assessment Methodology being applied to biodiversity certification strategies will deliver meaningful offsets that sustain biodiversity values.

Key Messages

Land use planning' (in recent literature, also called 'spatial planning'), as traditionally conceived in the legislation of developed economies has an important role to play in setting regulatory ground rules to support connectivity conservation initiatives. In particular, the zoning mechanism can be used to identify significant areas and to protect them from incompatible development. Regulation of existing land uses presents a greater challenge and legislation in some jurisdictions exempts them from land use planning controls altogether. A preferable approach is to provide compensation to landholders where modifications to current management practices are required to facilitate connectivity conservation. 402

However, persuading landholders to actively manage their land in ways that are sensitive to connectivity conservation considerations will require the use of tools that are not currently part of the land use planning system's tool-kit.

403 The challenge faced in adapting land use planning systems to the pursuit of connectivity conservation objectives stems from a land use planning culture that has traditionally focused on facilitating development, principally in urban contexts, which is appropriate in terms of the protection of human health and safety. As land use planning systems increasingly take on responsibility for regulating rural development, particularly agricultural activities, steps need to be taken to ensure that they are integrated with strategic conservation plans that identify areas that are ecologically significant. Special care must be taken in these areas to regulate development, and to ensure that any development that is approved is appropriate in terms of ecological sustainability, including connectivity conservation considerations. As a policy goal, modern land use planning legislation should require land use plans to be *consistent with* the provisions of conservation plans.

3.3 Development Control Legislation

Introduction

404 Development control legislation is crucial when it comes to protecting existing connectivity in intact landscapes, and guaranteeing long-term connectivity in fragmented landscapes that have been restored. Corridors that have been established have to remain clear of buildings and other obstacles. Wildlife tunnels crossing roads or other infrastructure have to remain accessible for animals; small landscape features such as hedgerows that provide connectivity have to remain in place, not just for a few years, but for a very long period of time. A wide variety of development control legislation has to be applied to achieve this.

405 This section begins by discussing the different ways in which development control can be delivered: through a land use planning system where this exists and/or stand-alone systems relating, for example, to environmental impact assessment, pollution or threatened species. It examines the role played by law in supervising discretionary decision-making by those deciding whether to grant approvals to carry out development, particularly in ensuring that the environmental impact of proposals is adequately considered. Finally, it explores the types of conditions that can be attached to approvals where they are granted, with a view to protecting existing connectivity and restoring it through biodiversity offsets.

3.3.1 Development control and connectivity conservation

406 **Development control linked to land use plans.** In jurisdictions with a land use planning system, a system of development control will normally be closely integrated with the planning system. Commonly, legally-mandated land use plans prohibit any development that is not consistent with the designated land use of a given area and/or allow for development only after formal approval has been given. For instance, once an area has been designated as a corridor or buffer zone primarily with a nature conservation function, developing this area into something else will be prohibited. Land use plans can also give multiple designations to an area, mostly allowing a combined use for agriculture and nature conservation purposes. Outside protected areas, nature conservation objectives do not have the same priority. Here, agricultural activities (or other activities not primarily related to the nature conservation function of the area) have to be regulated. They may be allowed as long as they do not destroy or limit the connectivity capabilities of the area. Depending on the particular legislation, the erection of

buildings and other fixed objects may be prohibited. This could be in the form of a complete ban or a conditional ban. In the latter case, a building permit or a more general land use approval decision will be required. Further, rules set in building codes may be applicable to building permits that are issued.

Where approval to carry out development is required, applications will be processed within the development control system to a point where a decision is made on whether approval should be given. The plan will provide guidance to government authorities responsible for deciding whether to grant approval in the form of, for example, objectives or performance standards. 407

Development control not linked to land use plans. Even where a jurisdiction does not have a land use planning system, most countries worldwide have some system for regulating development, at least in urban settings. At one level, there may be a system of *building* control. While the focus here is likely to be on health and safety aspects rather than on regulation for conservation, some building control systems may allow regulation of the design and siting of buildings. These provisions could be important tools for protecting conservation corridors that cut across urban or suburban areas. Other jurisdictions may have a separate system of *subdivision* control. This could explicitly recognize the authority to make decisions that, for example, require residential or industrial building blocks to be laid out in a pattern that is sensitive to connectivity conservation. 408

Where there is no functional land use planning system, development control may be integrated into legislation requiring environmental impact assessment of major projects. In many countries, legislation requires high level environmental assessment of specific types of major development falling into identified categories, or, more generally, all projects likely to have a significant impact on the environment (discussed further in section 3.3.2, below). This will be directly linked to a requirement under the legislation to obtain approval for these projects after the decision-maker has taken into account the environmental impact identified by the environmental impact assessment. 409

General environmental laws for pollution control, threatened species, water management, soil protection, the use of pesticides and fertilizers, etc., have a role to play as well (see section 3.1 above and examples in Boxes II(3)-12 and II(3)-13 below). Many laws are aimed at keeping the general environmental quality at an adequate level, principally to protect human health and safety, and forestry and agricultural production. But they may also be used to set specific rules for nature conservation in general or connectivity conservation in particular. A wide variety of options exist. The use of certain pesticides may be restricted; the amount of water that is used for irrigation may be regulated; emissions of certain pollutants may be controlled, etc. However, a great deal of development impacting on connectivity conservation objectives may fall through legal gaps unless there is explicit recognition in other legislation of the need to protect identified connectivity conservation features. 410

Box II(3)-12: Development control under threatened species legislation

In some jurisdictions, threatened species legislation may require approval for activities having an impact on listed species or their habitats. Under the U.S. *Endangered Species Act*, it is an offence to "take" a listed animal without a permit from the federal government, and this includes significant habitat modification or degradation where it harms the animal by, for example, interfering with breeding and feeding. In Australia, under the *Environment Protection and Biodiversity Conservation Act* 1999, activities likely to have a significant impact on listed species and ecological communities, including flora, require the approval of the federal government.

Box II(3)-13: Development control under pollution legislation

An example of a differentiated system of setting pollution controls to limit the negative impact on nearby natural areas is the permit system of the EU's Integrated Pollution Prevention and Control (IPPC) Directive (European Union, 2008). Under the IPPC, installations of certain types of industry as well as large scale agricultural animal keeping installations (bio-industry) have to obtain a permit in which emission limit values are to be laid down in order to attain a high level of protection for the environment as a whole (Article 1).

One of the provisions of the Directive stipulates that these emission limit values have to be set taking into account the geographical location of the installation and local environmental conditions (Article 9(4)). This provision requires the competent authority to take into account the presence of a connectivity area or connectivity landscape feature in the vicinity of the installation. While this provision will be deleted when the Industrial Emissions Directive replaces the IPPC Directive in 2014 (European Union, 2010), it illustrates the range of regulatory tools possible through pollution control legislation.

3.3.2 Discretionary decisions

411 Unless clear standards that must be met have been specified, a government decision whether or not approval of a development proposal should be granted, and the conditions attached to an approval, is normally a *discretionary* one. The decision-maker must exercise their own judgment within any constraints set out in legislation and any applicable land use plan.

412 **Considering environmental impact.** Development control legislation will often require that the decision-maker responsible for granting approval of a development proposal consider a list of factors before reaching a decision. Where there is no list, the relevant considerations may be deduced from the objectives of the legislation. A crucial issue in the context of connectivity conservation is whether the decision-maker in these circumstances is legally required to consider the environmental impact of a development proposal. If so, this could be interpreted to include the impact on natural connectivity in the context of climate change (see Box II(3)-14). In modern development control legislation, it is likely that environmental impact will be a matter to be considered. But this may not be the case in older legislation primarily concerned with managing urban and industrial development. Where there is no land use planning legislation, there may only be a requirement to consider *significant* environmental impacts following an environmental impact assessment.

413 Where development control legislation requires the decision-maker to consider likely environmental impact in deciding whether or not to approve a development proposal, there must be at least a minimal level of environmental assessment. However, unless the courts are prepared to supervise the depth of consideration to be given, this could vary considerably from jurisdiction to jurisdiction and be quite superficial.

Box II(3)-14: Court attention to impacts of development on connectivity

In the Australian state of New South Wales, the courts have held that legislation requiring decision makers to take into account the 'public interest' means that they must consider the principles of ecologically sustainable development. Amongst these principles are the precautionary principle, intergenerational equity and the conservation of biological diversity and ecological integrity "as a fundamental consideration" (Farrier and Stein, 2011, p. 10). Consequently, threats to connectivity posed by proposed development must be taken into account. ▶

A recent issue before the courts in New South Wales was whether the long-term effects of climate change *on* proposed development should be considered when development control decisions are being made (ELI, 2011, p. 89-90). In 2009, a NSW court held that the effect of climate change-induced coastal erosion *on* proposed beachfront development was a relevant consideration because it was an aspect of ecologically sustainable development (*Aldous v Greater Taree City Council,* 2009, NSWLEC 17 at 40). This position supports a persuasive argument that the long-term impacts *of* development on connectivity conservation in the context of climate change must be considered.

Requirements for formal environmental impact assessment. A formal process of environmental impact assessment (EIA) should be designed to produce information that will allow a decision-maker to carefully consider the environmental impact of a proposal, including the impact on connectivity (see Box II(3)-13). At a minimum, legislation requiring that the decision-maker consider environmental impact should specify that applicants support their applications with some material on which this consideration can be based. But this material may be produced at various levels of sophistication, ranging from a rudimentary desk-top assessment at one extreme to the preparation of a full-blown environmental impact statement based on substantial field work, including flora and fauna surveys, at the other. 414

Where legislation contemplates the preparation of a full-blown environmental impact statement in relation to only a limited range of development proposals, the basis on which these proposals are to be identified is an issue. One approach is for legislation to list specific types of development that require an environmental impact statement. It is, however, difficult to be comprehensive in identifying all types of development that ought to be subject to assessment at this level. For example, it is possible that even small-scale development that is inappropriately sited will have a substantial impact on connectivity conservation, for example, by creating a gap in a corridor. 415

A preferable alternative could be to rely on a general criterion relating not to the type of development, but to the extent of the environmental impact likely to result. The general criterion could be that a full-blown environmental impact statement is required where the proposed development is likely to have a *significant effect* on the environment. This decision will usually be left to the development control authority, but in some jurisdictions, the courts may be prepared to play a supervisory role (Farrier and Stein, 2011, p. 261-262). 416

In the EU countries, the Habitats Directive requires an 'appropriate assessment' of a plan or project 'in view of the site's conservation objectives' whenever the plan or project is "likely to have a significant effect" on the site (Art. 6.3, Habitats Directive). The impact of a project on connectivity is an issue for EIAs. This issue was recognized as legitimate to consider by the EU Court of Justice in a recent case involving an EIA that was carried out to assess the impact of open-cast mining projects in Spain. The Court examined whether the EIA had paid sufficient attention to the negative impact of these mining projects on connectivity, particularly the question whether projects create a barrier effect between the various pockets of habitat of the brown bear. The Court condemned Spain for not taking into account the risk from the proposed mining activities on the corridor between two populations of brown bear, as had been identified in the EIA. While the Court did not explicitly state in its judgment that EIAs must include connectivity impacts, this was an implicit finding (ECJ 24 November 2011, Case C-404/09 *Commission v. Spain (Alto Sil)).* 417

Assessing the adequacy of EIA. Usually, the initial phase of the EIA is left to the applicant seeking development approval. This is justified on the grounds that it will help integrate environmental assessment into private decision-making processes. However, there should be some provision for reviewing the adequacy of the EIA. One approach is for the development control authority to carry out a review of 418

a draft environmental impact statement, with the power to ask for it to be supplemented where it is inadequate. In modern legislation, there increasingly are provisions requiring the development control authority to forward the draft of an environmental impact statement to appropriate environmental specialists within government for comment and recommendations as to approval and conditions to mitigate negative impacts. In some jurisdictions, the courts are prepared to assess whether an environmental impact statement substantially complies with legal requirements relating to content (Farrier and Stein, 2011, p. 266-267).

419 The EIA process does not offer any legal guarantee that the predicted environmental impact of a proposal will be given significant weight in the decision-making process. However, the decision-maker is less likely to dismiss conservation concerns in the face of a detailed EIA, particularly where this does not simply rely on existing material but is based on detailed site surveys, producing new information about the conservation significance of an area. Where, as is commonly the practice, a full-blown environmental impact statement must be available for public comment, this transparency places additional pressure on the decision-maker to take environmental impact considerations seriously and allows scrutiny and monitoring by stakeholders and other concerned Parties, including NGOs.

420 It should be noted, however, that an EIA process at the stage of development control may be limited as a tool for connectivity conservation. Because its focus is on the environmental impact of a specific development proposal, the process may not have the scope to adequately assess impact on connectivity over time or over a larger scale than the project. One way to begin to address this problem is to include reporting and monitoring requirements on a larger scale as part of the EIA process. In addition, the connectivity conservation values of a site may have been previously identified at a landscape scale during the land use planning process, for example, through a regional inventory. In such cases, the EIA process may play a significant role in ensuring that any approval includes conditions, including monitoring conditions, designed to mitigate the negative impact of the development on those values.

421 **Integrating connectivity conservation into the approval process.** In protected areas legislation, we expect nature conservation to be given primacy in the decision-making process by, for example, requiring all decisions to be *consistent with* conservation objectives. Along similar lines, it would be possible for development control legislation to require that in the decision-making process significant weight be given to environmental considerations, including connectivity conservation. Legislation could, for example, take the position that approval should *not* be given to any development proposal likely to have a significant negative impact on the environment, for example a proposal that would place barriers in the way of wildlife movement between two protected areas.

422 This is not the approach traditionally taken in development control legislation. In the development control context, there is traditionally a list of often competing factors that the decision-maker must *consider*. In crude terms, these range from the social and economic need for development at one extreme to conservation at the other. While the likely significant environmental impact of a proposal may trigger procedural requirements to prepare a detailed environmental impact statement, the results of this assessment are normally one of a number of factors that must be taken into consideration.

423 Where legislation does not indicate what weight is to be given to the different factors that must be considered in the development control process, this is left to the decision-makers (Bell and McGillivray, 2008, p. 409-411; Farrier and Stein, 2011, p. 43). In effect, decision-makers are invited by the legislature to give weight to the different factors on a case-by-case basis without clear guidelines. This means that where decision-makers, such as a local council or a government minister, are elected, their political values relating to how tensions between development and conservation should be resolved may legitimately come into play when they are making their decisions. Without clear guidelines or criteria

on how to 'balance' competing considerations, government officials, appeal tribunals and courts responsible for making decisions are put in a similar situation, although the values of those entities may be less explicitly at play where they are not elected officials or political appointees.

Prioritising conservation in the approval process. In some jurisdictions, there appears to be a shift in focus, with emerging examples of conservation being given priority over short-term socio-economic imperatives in development control decision-making processes. This offers considerable potential when it comes to pursuing connectivity conservation objectives. One example can be found in the EU Habitats Directive. Unless certain preconditions are satisfied, including that there are "imperative reasons of overriding public interest", projects that will potentially have a significant effect on a Natura 2000 site may proceed only after an assessment has shown that the site's ecological integrity will not be adversely affected (Art. 6(3),(4)). (This is discussed further in section 2.2, of this Part, above.) 424

Another example is contained in legislation relating to biodiversity offsets in the Australian state of New South Wales. Under this legislation, those seeking approval for development can choose to apply for a certification that their overall development proposal, combined with proposed biodiversity offsets, "improves or maintains biodiversity values" (see Box II(3)-15). What this means is that however great the likely socio-economic benefits of the proposed development to the landholder and the broader community, there is a condition that must be met before any approval of the project: the overall effect on biodiversity values, including connectivity values, must be at least neutral. The issue becomes an empirical one rather than one to be determined by the exercise of discretion in a context of competing considerations. Approval cannot be given to a proposal that has not passed the "improve or maintain" test. However, applicants are not required to pursue the certification route through the development control process: it is optional. 425

3.3.3 Approvals with conditions attached

If approval is given to an application to carry out development, conditions are likely to be attached to the approval. Where environmental impact is a factor to be considered during the decision-making process, conditions can require protective or mitigating measures to be taken. For example, in one Australian case it was held that conditions based on the precautionary principle should be imposed on a wind farm development to ensure that measures would be taken to deal with any occurrences of threatened flora if they were discovered during or subsequent to construction (*Taralga Landscape Guardians Inc v Minister for Planning* [2007] NSWLEC 59). 426

Conditions attached to approvals are likely to have a significant role to play in protecting connectivity conservation values. As already discussed, in many situations connectivity conservation values may be able to tolerate a certain degree of development of a site where this is compatible with the site's overall conservation purposes. For example, it might be possible to reconfigure a development so as to maintain a conservation corridor. Or, conditions might regulate particular aspects of an approved development, for example, by restricting the keeping of dogs and cats, so that the site continues to function as a buffer around a protected area. Wildlife bridges or underpasses may need to be built where roads prevent animal migrations. Similarly, development on land adjacent to a conservation corridor may need to be carefully regulated through conditions to prevent impacts on the corridor caused by, for example, diverting water for irrigation. However, where substantial changes are involved this might need to be dealt with by initially refusing approval altogether and allowing the applicant to resubmit a modified application with mitigation measures to reduce negative impacts on the corridor. 427

428 As seen in above in section 3.2.4 of this Part, a significant obstacle to restoring connectivity in fragmented agricultural landscapes is that existing use rights are often substantially exempted from regulation under land use plans. However, legislation may allow conditions to be attached to an approval requiring the modification or surrender of existing use rights. This is particularly important when these existing use rights constitute a greater interference with the connectivity conservation values of an area than the proposed development. This may be the case, for example, where existing use rights go as far as to allow land to be converted from traditional agriculture to agro-business operations.

429 Development control systems generally insist that conditions must be directly related to a proposed development: there must be a *nexus* between the development and the condition. In particular, conditions that involve the applicant spending money or dedicating land for community facilities are likely to be viewed with suspicion if they are not clearly linked to the development (Farrier and Stein, 2011, p. 218-288; England, 2011, p. 210-218). The basic idea is that the broader community, not the developer, should have to pay for facilities not directly attributable to the development. One way of defining the applicant's responsibilities is to ask whether the proposed development 'generates a public need' for a particular facility (see Box II(3)-15)

430 **Modifying conditions for climate change.** There is a persuasive argument that, where they are granted, approvals should contain a 'reopener clause" that allows them to be suspended or modified to re-evaluate impacts with a view to halting further degradation (ELI, 2011, p. 94). This is crucial where it is difficult to predict the precise impacts when approval is initially sought. Traditionally, this level of flexibility has not been contemplated in development control systems associated with land use planning legislation. This is in contrast to other approvals, for example, pollution licences, which are subject to ongoing adjustment to reflect changing standards. Development approvals ordinarily cannot be varied, and where they can compensation must be paid (Bell and McGillivray, 2008, p. 374; Farrier and Stein, 2011, p. 238-239). However, where legislation contemplates the possibility of conditions being imposed to limit the time-span of an approved development, then this could be used as the basis of a reopener clause and potential mitigation measures.

Box II(3)-15: Providing a corridor as a condition of development approval

If a proposed development creates a gap in an existing corridor by clearing native vegetation then a condition of development approval that would be justified would be to require the developer to dedicate or pay the cost of purchasing other land to provide a substitute corridor as an offset. Here, clearing native vegetation generates a need for the offset because of the loss of biodiversity. Similarly, a condition requiring dedication of land along a creek might be justified on the grounds that it acts as a filter strip for drainage from the proposed development. In these circumstances, the development generates a need for the filter strip. As a side effect, the filter strip may also act as a wildlife corridor.

The issue is to determine the justifiable link between the proposed development and the conservation condition. Absent a direct link with the development, a condition requiring an applicant to contribute money or land towards establishing a conservation corridor adjacent to the development would not be justifiable because the proposed development itself does not generate a need for the conservation of other land. The need to require an offset stems from the intrinsic characteristics of the land and whether its conservation functions will be clearly diminished by the proposed development.

431 **Requiring biodiversity offsets.** Biodiversity offsets are designed to require those carrying out development to compensate for the public costs associated with loss of nature conservation values attributable to development. Requirements to offset the effects of development can be attached as conditions to development approvals. However, the first principle of offsetting is that it should only be used as a last resort, after initial steps have been taken to modify the development proposal on site, so as to avoid or mitigate conservation impacts.

Offsetting is well-developed in Australia (see Box II(3)-16 below) and the United States, and is currently being explored in the development control context in the United Kingdom (see http://www.defra.gov.uk/environment/natural/biodiversity/uk/offsetting/). As already discussed, under the European Habitats Directive (Art. 6(4)), in the exceptional situations where approval can be given in spite of the fact that a proposal is likely to have a significant effect on the environment of a Site of Community Importance, 'compensatory measures' must be taken (see Box II(3)-17 below; for a detailed discussion of the EU situation, see section 2.2 of this Part). 432

In sophisticated schemes, biodiversity credits which can be used for offset purposes are created by active conservation management of a degraded but recoverable area of an existing ecosystem on another part of the development site, or a separate site, to increase its conservation values. These can then be used to compensate, ideally in a measurable way, for the loss of nature conservation values caused by development. The objective is to ensure that there is no net loss of nature conservation values and ideally an improvement. What this means is that offsets should ideally be in an area that has the same ecological characteristics as the area to be developed and must be secure over the long term. This tool has significance for protecting existing conservation connectivity values threatened by development. The idea would be that the conservation values of the proposed development site in its landscape, including its relationship to other natural areas, would need to be taken into account in identifying appropriate offset areas. 433

It is possible to combine a requirement for biodiversity offsets with the creation of a market in biodiversity credits (generally known as conservation or habitat banking, discussed in more detail in section 3.5 below). What this means is that instead of developers having to search for or create the offsets themselves, offset credits can be purchased from landholders who are actively managing degraded but recoverable land to enhance biodiversity values. For this scheme to work, landholders should be rewarded for their conservation efforts by the price that developers seeking the offsets pay for the biodiversity credits created. 434

Other offset schemes are less sophisticated. Some schemes do not create a system of credits that can be bought and sold in the private marketplace. Instead, one approach is simply to require a developer to pay an amount of money into a government fund from which payments are made for general conservation initiatives by others. These initiatives could explicitly include connectivity conservation. This represents a simple application of the polluter pays principle, with the developer being required to pay what is essentially a charge designed to reflect the public costs of development. 435

Another approach could be to allow an offset simply by securing long-term legal protection and management for an area that is already of high conservation value. A conservation agreement in perpetuity could be used for this purpose (see section 3.4 of this Part). However, such an approach will likely result in an overall loss of nature conservation values where there is no means to ensure full replacement of the conservation values lost on the development site. 436

Box II(3)-16: Biodiversity offsets in New South Wales (NSW)

Under the *Threatened Species Conservation Act 1995*, in areas zoned for urbanisation in the Australian State of NSW, those seeking development approval who are prepared to offset the impacts of proposed development on nature conservation values can choose to apply for a statement certifying that their overall development proposal incorporating biodiversity offsets "improves or maintains biodiversity values", as measured using a scientific methodology (ss 127ZJ-127ZS) (http:www.environment.nsw.gov.au/biobanking/assessmethodology.htm). ▶

Under this scheme, the overall effect of the combination of the development and offset must either be neutral or beneficial in delivering biodiversity outcomes. This involves comparing the adverse impact of the proposed development with the predicted positive impact of active management of the offset area, using the detailed rules spelt out in the methodology. Ideally, offset sites should already have been remediated so that biodiversity credits are in place to provide an immediate offset. But in practice landholders are hesitant to commit to management until they have a likely buyer. The result of this is that in the short-term there will be loss of biodiversity values.

Under the methodology, biodiversity values are measured along two dimensions. Vegetation is the principal surrogate for biodiversity, but threatened species that cannot be reliably predicted to use an area of land based on habitat surrogates are assessed separately. The value of vegetation is assessed at two different levels. *Site Value* is a measure of the structural, compositional and functional condition of vegetation, including species richness, ground and storey cover, and extent of weed coverage. *Landscape Value* is a measure of the relationship between native vegetation cover on the site and in the surrounding area, including adjacency to and connectivity between vegetation on the site and neighbouring vegetation.

The commitment under the scheme is that development proposals incorporating offsets will improve or maintain biodiversity values. This is not a commitment to no net loss of habitat area. It is quite possible for a certified project to result in a net loss of the area of habitat provided that there is an increase, through active management, in the *quality* of habitat on the offset site.

Certain areas are declared to be 'red flag' areas. In these areas, offsetting to satisfy the 'improve or maintain' test is only allowed in very limited circumstances, for example, where there is a determination that the contribution of the area to regional biodiversity values is low and that the biodiversity values of the area are not likely to persist over the long-term (such as in relatively small and isolated areas). 'Red flag' areas include endangered ecological communities, and vegetation types assessed as being over-cleared (over 70% of the original estimated distribution has been cleared), except where the vegetation is classified as being in low condition (because restoration is unlikely).

This offsetting scheme is linked to a conservation banking scheme, known as biobanking in NSW, through which biodiversity credits can be bought by those carrying out development and used as offsets (see Box II(3)-21, below).

Developers do not have to apply for certification. They can choose to pursue the traditional path to securing development approval, but they may still face informal offset requirements. A significant incentive for seeking a certifying statement is that, once received, the statement exempts the developer from the need to prepare a species impact statement to support their development application. This exemption saves both time and money.

Box II(3)-17: Biodiversity offsets in the European Union

According to the EU Habitats Directive, a project with negative impact on a Natura 2000 site may still proceed after certain obligations have been met. One of these is the obligation to compensate for the loss of the specific function of the Natura 2000 network (see section 2.2 of this Part, above). For instance, if a railway has to be constructed because of imperative reasons of overriding public interest, and this railway cuts through the habitat of a certain species of bird, then compensatory measures are required aimed at restoring or recreating habitat for that specific species so that the site will keep its function for that species within the network.

A more elaborate system of offsetting exists in the Netherlands where, under spatial planning laws, infringements on the national ecological network (see Box II(3)-6 above) are only allowed under certain conditions. One of these conditions is that the infringements must be offset in accordance with a detailed standard that states there should be no net loss of area, of quality and of connectivity within the ecological network. In practice this condition leads to the recreation or restoration of new areas to be included in the network, often through land swaps or land purchases by the project developer.

It should be noted, however, that in the past few years, developers have favoured the option of designing projects in such a way as to avoid a negative impact, for instance, by integrating mitigating measures into the project (Verschuuren, 2010). Connectivity measures, such as wildlife flyovers or wildlife tunnels, are then integrated into the design of the railway, to continue the above example. The legal advantage of this option is that it avoids the complex and difficult task of making provision for compensatory measures (see section 2.2 of this Part, above).

Key messages

437 Regulation of development is crucial not only in securing existing connectivity but also in ensuring that already fragmented landscapes that are being rehabilitated are protected from inconsistent

development. Jurisdictions with developed land use planning systems that cover both urban and rural areas, have the greatest potential for delivering comprehensive controls over development. Where this is not the case, regulation of development may be patchy. For example, legislation that focuses on the assessment and regulation of development likely to have a significant effect on the environment, while extremely important, may not adequately protect connectivity areas against the cumulative effects of a number of small-scale developments.

438 To support connectivity conservation objectives, legislation needs to make it clear that approval bodies, in deciding whether approval should be given, and if so, under what conditions, have to take nature conservation values into account before making decisions, and ideally to give them significant weight. Environmental impact assessment legislation has a crucial role to play in this regard, as well as in making the decision-making process transparent and participatory. Going much further than this, however, in some jurisdictions there is the beginning of a movement towards imposing conditions on approvals requiring unavoidable negative effects of development on nature conservation values, including loss of connectivity, to be offset. This may mean that nature conservation values on another site must be restored to compensate for those lost on the development site. This is scientifically controversial because of the difficulty of determining that the biodiversity values being gained are indeed equal to those being lost. While offsetting does ensure that the developer pays in some way for lost biodiversity values, the preferred approach should be to permit development only in very exceptional circumstances in areas which are already significant for biodiversity conservation, including for connectivity.

3.4 Voluntary conservation agreements

Introduction

439 Voluntary conservation agreements are a principal instrument available to governments to pursue a voluntary approach to land or resource management where they do not own the land or resources in question themselves. Agreements can be used to get binding commitments from landholders to manage their land or resources so as to achieve connectivity conservation objectives. These agreements can be used as an alternative to direct regulation, but they are also often used to complement it. This might be a good combination, for example, where the future development of land is controlled by direct regulation and agreements are then used to ensure that it is actively managed for conservation. Negotiating agreements with individual landholders or those holding rights over natural resources is a time consuming exercise in many cases, especially where there are complex management needs, incentive structures, and other detailed conditions to meet. However, this tool has considerable potential for achieving connectivity conservation objectives when successfully negotiated, with clear obligations and implementation responsibilities understood and voluntarily accepted by all Parties.

440 Agreements are voluntary. Decisions by landholders will be influenced by their motivations and the context in which agreements are made. Some landholders will be motivated by a conservation ethic to enter into an agreement to protect the conservation values of their land over the long-term and will require little incentive beyond this. Others, however, may be largely motivated by economic considerations when deciding whether to commit themselves. In some cases, the primary reward may lie in the market-place, for example, by facilitating ecotourism operations. But for many landholders, the availability of additional incentives to enter into an agreement will often be crucial. A connectivity conservation initiative will be undermined if significant landholders in the area refuse to come on board. This may result in a gap in a corridor or missing habitat patches required by particular plants and animals. Consequently, substantial economic incentives may have to be paid. Under South Australia's *Native Vegetation Act* 1991, for example, a heritage agreement may provide not only for the remission

of rates and taxes but also compensation for loss in land value resulting from the agreement, as well as a further amount as an incentive to enter into the agreement (s 23A). Compared with economic incentives delivered through tax systems or direct payments to landholders, voluntary agreements can be more carefully targeted at those who own land valuable for connectivity conservation. Incentives are discussed in more detail in section 3.5 of this Part, below.

441 There are three interconnected issues important to address here in relation to voluntary conservation agreements:

- Who should be able to enter into an agreement with a landholder or resource rights holder.
- What should agreements be about.
- What level of security should agreements provide.

3.4.1 Agreements between whom

442 In some countries, agreements were historically reached between landowners themselves in order to protect the amenity values of each property by, for example, restricting the height of development on neighbouring land. These were binding on the parties to the agreement under the law of contract. The issue that arose was whether they 'ran with the land'. In other words, could the agreements be enforced against a subsequent purchaser of the land when that purchaser was not a party to the original agreement. This was a key issue for securing land use commitments in perpetuity.

443 Many courts responded to this by imposing conditions that had to be met before land use agreements would run with the land. Courts would only enforce two kinds of agreements:

- *restrictions* on land use and development ('restrictive covenants', not requirements to carry out active management or development, and
- restrictions that particularly *benefited neighbouring land* owned by the person seeking to enforce them.

444 As a result, NGOs that own private protected areas can seek to *restrict* development of private land in buffer zones by persuading neighbouring landowners to enter into voluntary conservation agreements that bind future purchasers of the *neighbouring land*. However, in the absence of legislation, an NGO cannot pursue a general policy of relying on land use agreements with landowners as an alternative to purchasing and managing the land itself.

445 The traditional justification for this narrow application of such restrictive agreements was the fear that one generation would be able to impose its wishes on future generations' use of a scarce commodity. However, where the objective of the agreement is to prevent degradation and destruction of natural values, its aim can instead be interpreted as keeping options open for future generations rather than foreclosing future options. This interpretation is in line with the environmental principle of intergenerational equity.

446 The reality today is that development, not conservation, is increasingly foreclosing options to future generations where it damages or destroys natural values. Some jurisdictions have responded to these restrictions imposed by the courts with special legislation that allows conservation agreements to be negotiated and concluded by those who do not own neighbouring land. In the USA, for example, legislation enacted by a number of states has modified the common law position by enabling a government agency or charitable NGO to hold so-called *conservation easements* over private land which are legally recognized to 'run with the land', regardless of whether the agency or NGO owns

neighbouring land that is benefited by the easement (McLaughlin, 2005, p. 426). Equivalent legislation exists in a number of Canadian jurisdictions (Benidickson, 2010, p. 25-26). Conservation easements are now being widely used by NGOs such as The Nature Conservancy and other land trusts to negotiate land use restrictions as well as active management obligations on private land of high conservation value. In Peru, while there is no special legislation, conservation-related land use restrictions benefiting other landowners can be put in place under provisions of the Civil Code (Solano, 2010).

Australia, in contrast, has enacted legislation modifying the common law position only so far as to allow 447
specified government conservation agencies or trusts operating under special legislation to enter into voluntary conservation agreements that run with the land, thus excluding NGOs. The Commonwealth and each of the Australian states have legislation that enables specified government Ministers and/or nature conservation trusts set up by government to enter into what are variously called conservation or heritage agreements. In NSW, for example, the Environment Minister can enter into voluntary conservation agreements not only with private landholders but with government agencies, such as the forestry agency, that are in control of public land. Agreements can also be reached with those who lease public land (*National Parks and Wildlife Act* 1974 (NSW), ss 69A-69K). This is extremely important given that significant areas of inland NSW are held under leasehold tenure, including perpetual leasehold.

3.4.2 Agreements about what

In the context of connectivity conservation, legislation authorizing voluntary conservation agreements 448
must have objectives that can include connectivity conservation, even though this may not be explicit. For example, references in Australia's *Environment Protection and Biodiversity Conservation Act* 1999 to promoting biodiversity conservation and in Ontario's *Conservation Land Act* 1990 to conserving wildlife are clearly broad enough for these purposes. This may not, however, be the case in the Australian state of New South Wales. Here, agreements can be entered into for areas containing natural environments or phenomena 'worthy of preservation'. While the reference to 'preservation' of natural environments may be quite appropriate where an area is in pristine condition, it may be interpreted as setting the bar too high in situations where some productive uses can be tolerated in a conservation corridor. At the same time, other specific provisions of the New South Wales legislation allowing for agreements designed to conserve species and ecological communities listed as threatened could possibly be used to justify connectivity conservation agreements in some situations. This might occur, for example, where a conservation connectivity agreement protects a corridor through which a listed species moves between protected areas, without restricting adjacent productive uses that are compatible with the purpose of the corridor.

From a connectivity conservation perspective, voluntary conservation agreements could address one 449
or more of three general objectives:

- restrict future development to preserve existing connectivity,
- restrict or modify existing uses to improve connectivity,
- actively manage land to maintain or improve connectivity.

Controlling future development. Voluntary conservation agreements are not usually appropriate 450
tools for controlling development. Unaffordable incentives would be necessary to persuade many landholders to forego development opportunities voluntarily. In jurisdictions where a development control system is in place, particularly where it is linked to a land use planning system, it is likely that this will perform the job of regulating future development. In other words, development will be controlled through direct regulation rather than negotiation and agreement.

451 **Controlling existing uses.** Land use planning and development control systems may not control existing uses and management practices (see section 3.2.4 of this Part, above). In these circumstances, one aim of a voluntary conservation agreement could be to persuade a landholder or rights holder to modify existing management practices to facilitate connectivity conservation by offering compensation for lost productivity.

452 **Active management.** It has already been emphasised that active management of connectivity conservation areas is crucial. From an *intra*generational equity perspective, there is a strong case for paying landholders for active land management where this goes beyond their duty of care for the land (duty of care is discussed in Part I, section 3). The availability of incentives, particularly to cover additional costs associated with specific management practices, may be an important factor in motivating some landholders to enter into active management agreements.

453 It should be remembered, as discussed above, that under common law, land use agreements will only be enforced against future purchasers of the land if they are *restrictive* agreements. Active management provisions in such agreements will not 'run with the land'. This gap is now ordinarily filled by legislation. So for example, under the Australian *Environment Protection and Biodiversity Conservation Act* 1999, the Minister can enter into agreements requiring the landowner not only to refrain from actions or processes that may adversely affect listed species, ecological communities and their habitats, but to carry out specified *activities* that promote biodiversity conservation (s 306(2)). Similarly, the Canadian province of Ontario's *Conservation Land Act* 1990 provides for agreements to cover the "conservation, maintenance, restoration or enhancement" of land or wildlife (s 3(2)).

454 One additional potential tool to support active management of important connectivity conservation lands is the 'revolving fund'. The idea behind the development of a revolving fund is to secure the lands from willing landholders who may not have the capacity or desire to actively manage the lands themselves and are not prepared to enter into a voluntary conservation agreement. Box II(3)-18 explains the concept as it is being used in the Australian state of New South Wales where many of the new tools discussed in this section of the paper are being employed.

Box II(3)-18: Revolving Funds

Legislation in the Australian state of New South Wales provides a conservation trust that has been set up by government with a fund to purchase land from willing landholders as an alternative to seeking voluntary conservation agreements. If the agency is successful in persuading landholders to sell their land outright, it can then sell it on to more conservation friendly purchasers. When it does this, it can ensure the long-term conservation of the land by requiring those purchasers to enter into voluntary conservation agreements. The proceeds from these sales can then be reinvested in purchasing other properties. These can, in turn, be sold off subject to voluntary conservation agreements (*Nature Conservation Trust Act* 2001 (NSW), s 7). And so on. This is why the fund is referred to as a revolving fund.

Provided that the existing landholder can be persuaded to sell their land, the revolving fund allows the conservation trust to sell it on to those who are motivated and good conservation managers. Even where existing landholders are prepared to enter into conservation agreements to obtain the incentives offered, they may not be the most appropriate manager from a conservation perspective, and this could lead to compliance problems.

3.4.3 Security of agreements

455 Perpetual integrity has been regarded as a key criterion for formal protected areas. In practice, this means "providing safeguards to secure an area, by the best means available, for the long term" (Lausche, 2011, p. 17). Conservation agreements that have no fixed duration and 'run with the land', binding not only the original landowner but also subsequent purchasers, clearly satisfy this requirement.

Whether a similar level of security should be required of connectivity conservation areas is a new policy question. Conservation NGOs may be motivated to set up conservation areas on land which they own. In contrast, landholders in working landscapes who do not have strong conservation values might be reluctant to commit themselves over the long term. This might be a significant issue particularly at the outset of a management arrangement when its precise impacts on the productive capacity of the land are uncertain. In some cases, a useful strategy will be to negotiate a short-term agreement to secure an initial commitment from the landholder to provide a trial period in the hope of extending the length of the commitment overtime so long as it is working well. 456

There are legislative techniques that may give some flexibility to commitments that are long-term. For example, Australia's *Environment Protection and Biodiversity Conservation Act of 1999* provides that while such voluntary agreements generally 'run with the land', the precise duration is determined by the terms of the agreement itself (s 306(1)(g)). This legislation also provides government with an escape clause that allows the Minister to unilaterally terminate or vary an agreement without compensation if satisfied that it is not capable of achieving its stated purpose (s 308(4)). 457

This underscores the point that such agreements can be made more secure if their conservation purposes and objectives are clearly stated, and this applies as well to connectivity conservation purposes. In addition, escape clauses such as the Australian example provide government with a level of flexibility in the context of uncertainties, including climate change. Escape clauses also allow government to extricate itself from a connectivity conservation initiative that attracts early support from a landholder but fails to attract sufficient support or generate sufficient results over time to make it viable in the long term. In the USA, where there has been significant growth in land area covered by voluntary conservation agreements (often through 'conservation easements'), the vast majority of which are perpetual and run with the land, research has pointed to the need for such agreements to be clear about their intended purposes so that periodic reviews required under the agreement or by law are satisfied that implementation actions are fulfilling those purposes and in compliance (McLaughlin, 2005, pp. 423-428). (See Box II(3)-19 for a discussion of some of the special compliance challenges with agreements requiring active management.) 458

Legislation should not, however, be so open-ended as to allow government to unilaterally undermine the purpose of an agreement by facilitating development that may be incompatible with connectivity conservation objectives. This is the case, for example, where legislation exempts mining from complying with the objectives of a voluntary conservation agreement. In Australia, mining is permitted even where an agreement is in place (Anderson, 2011). Conservation agreements in the state of New South Wales are even more fragile because they can be set aside by land use plans to allow any development to proceed, provided that the Environment Minister agrees (*Environmental Planning and Assessment Act* 1979 (NSW), s 28; *National Parks and Wildlife Act* 1974 (NSW), s 69K). 459

Box II(3)-19: Ensuring compliance with management agreements

Compliance with a voluntary conservation agreement may become an issue, particularly where the agreement involves not simply land use restrictions but obligations to actively manage the land. Where land has been sold and is no longer in the hands of the person who originally entered into the agreement, problems of compliance may be magnified. Purchasers may buy land, perhaps at a discount, knowing of the existence of management requirements imposed by an agreement. This fact, however, does not necessarily mean that they will be enthusiastic about complying with the management requirements or that they will have capacity to do so. Formal legal proceedings to try to enforce these management requirements may cause further alienation.

Legislation needs to provide adequate remedies. Payment of monetary damages will not be satisfactory from a conservation perspective, but a court may be reluctant to order the performance of management obligations under the agreement because it will then become involved in supervising whether the performance is adequate. Another approach would be to authorise the NGO or government agency that wishes to enforce the agreement to carry out the management requirements itself and to charge the landowner. But an NGO may not have the capacity to carry out on-ground management. In these circumstances, NGOs and government agencies that have entered into agreements may prefer to rely on persuasion and technical assistance rather than committing resources to formal enforcement proceedings.

Key messages

460 Active management of land is a vital component of connectivity conservation initiatives. Targeted conservation agreements voluntarily negotiated between government agencies or NGOs, on the one hand, and landholders or those with rights over natural resources, on the other, are an essential mechanism for achieving active management. They are an important mechanism for delivering targeted incentives. In jurisdictions where land use planning and development control systems do not regulate existing uses, voluntary conservation agreements also have a crucial role to play in modifying existing management practices.

461 To provide adequate security, agreements containing active management obligations should not only bind landholders who enter into them but also those who subsequently purchase the land. Ideally they should last in perpetuity, although many landholders are likely to prefer fixed terms. Even a relatively short fixed-term agreement, however, can form a building block for gaining a long-term commitment.

3.5 Economic and market-based instruments aiding connectivity conservation

Introduction

462 Economic and market-based instruments are an alternative approach to direct regulation (sometimes referred to by economists as the ‘command and control’ approach) such as that found in the land use planning and development control systems discussed in sections 3.2 and 3.3 of this Part, above. Under threat of penalty, direct regulation prohibits activities that cause damage or have the potential to cause damage to connectivity. Direct regulation does not allow any choice but to comply if you want to stay within the law. Economic instruments, on the other hand, do allow those subject to them an element of choice. They use price signals to change behaviour rather than commands. The price signal may be negative: if you damage connectivity, then you must pay a charge. Or it may be positive: if you manage your land to achieve connectivity conservation objectives you will receive a financial reward.

463 The Convention on Biological Diversity supports the use of economic instruments by calling on Parties to “as far as possible and as appropriate, adopt economically and socially sound measures that act as incentives for the conservation and sustainable use of the components of biological diversity” (Art. 11). The CBD COP has made a number of statements dealing with the implementation of this provision.

In the context of biodiversity conservation, some economic instruments, such as charges and taxes, are designed to remedy failures in the market place by making those carrying out activities such as development pay for any 'negative externalities'. Negative externalities are environmentally harmful side-effects of these activities that impose costs on the broader community (such as damage to natural values and ecosystem services caused by pollution). In the past, those responsible have traditionally not paid for these costs, and the broader community has effectively subsidised the activity by bearing the costs. 464

Other economic instruments, such as management payments to landholders, are designed to reduce market failures by paying for 'positive externalities'. These are environmental side-effects that are beneficial for the community, but for which the community has not traditionally paid (such as active management of private land by landholders to achieve nature conservation objectives). 465

Even though economic instruments are often presented by economists as alternatives to direct regulation, in practice they are frequently used in combination. For example, development proposals on a substantially intact ecosystem may be controlled through direct regulation, with payments then offered to landholders both as compensation for opportunity costs and an incentive to manage the land for connectivity conservation. 466

Economic instruments are defined by the OECD in a broad sense to include "all instruments that change the incentives individuals face for undertaking particular actions" (OECD, 2004). A number of broad categories which are relevant to connectivity conservation can be identified: 467

- **Payments and fiscal advantages** (positive incentives): payments (subsidies, administrative contracts) or tax reductions by public authorities and payments by private ecosystem services users to landholders to promote active management for connectivity and/or to compensate for opportunity costs in halting current unsustainable management;
- **Funds**: direct funding of connectivity conservation programmes by public authorities or public-private partnerships;
- **Market creation**: creation by government of markets, based on assignment of property rights to elements of biodiversity, and in which developers pay for connectivity offsets;
- **Fees, taxes and charges** (negative incentives): imposed by government to discourage activities that are harmful to connectivity conservation or to fund conservation projects as a type of 'offset';
- **Removal of 'perverse incentives'**: government support for social and economic objectives should be removed where they have harmful side-effects on natural values even though this is not their objective (for example, subsidies for the use of fertilizers and pesticides);
- **Labels and certification schemes** aimed at biodiversity conservation outside PAs.

The discussion below focuses on the first three of these categories because they are most frequently used to achieve specific connectivity conservation objectives. 468

3.5.1 Payments and fiscal advantages (positive incentives)

Among economic instruments, positive incentives for biodiversity conservation based on the granting of a financial or fiscal advantage are the most frequently used because of their purely voluntary and non-stigmatising character. These instruments include payments or tax reductions by public authorities and payments to landholders to promote active management for connectivity or to compensate for opportunity costs in halting unsustainable management. 469

470 Payments may be delivered by individual contracts between the landholder and a public authority (for example, a voluntary conservation agreement) (see section 3.4 above) or the private user of an ecosystem service (for example, a water production company). On the one hand, this allows a space for negotiation with landholders, but on the other hand the transaction costs may be very high and the procedure time-consuming. Alternatively, government may use unilateral subsidies, conditional on carrying out specific commitments described in a uniform regulation (for example, agro-environmental measures in some EU Member States, discussed below). This solution allows large scale payment schemes and reduces transaction costs, but is less flexible than the contractual approach. Public procurement procedures may also be used to allocate funding to landholders committing to specific conservation practices on the basis of calls for tenders.

471 Despite the attractiveness of such instruments to landholders, they are not without their flaws. Their voluntary nature involves a risk to the sustainability of connectivity conservation achievements because land use remains a matter for individual landholders. This can make public investment less efficient, in comparison to command and control or land policy measures. Only combinations of incentives and mandatory requirements may avoid such risks.

472 For some examples of financial incentive schemes run by public authorities, see Boxes II(3)-20 and II(3)-21, below.

Box II(3)-20: United Kingdom and environmental stewardship

National authorities in the various EU Member States have set up financial instruments aimed at biodiversity conservation generally, which can be applied to connectivity measures. In the UK, for example, farms, under the Environmental Stewardship Scheme, have to comply with a Farm Environment Plan that provides for voluntary and mandatory conservation measures. Farms operating without or in breach of such a plan will not get subsidies. There are two tiers to the scheme. The entry level is not confined to areas that are specially significant, so that it is open to most farmers (Bell and McGillivray, 2008, p. 746).

Another example from England and Wales of a financial instrument is the Hedgerow Incentive Scheme, which is a voluntary scheme offering financial incentives for the restoration of hedgerows. For smaller species, hedgerows can provide essential connectivity.

Box II(3)-21: The Netherlands: financial incentives for nature conservation

In the Netherlands there exists an elaborate scheme for financing private nature conservation measures, the 2011 subsidy programme for nature and landscape management (*Subsidie Natuur- en Landschapsbeheer*) (SNL). This is a new programme that is a simplified and more integrated version of previous programmes in existence since 1975. Under the SNL, both farmers and other private landowners can apply for subsidies within a six year period to finance projects within the Netherlands Ecological Network (see Box II(3)-6 above). The projects are grouped together in so-called packages. Individual applicants have to subscribe to one or more of these packages. They get funding for the execution of such a package. There are basically two groups of packages: those aimed at farmland, and those aimed at natural habitats.

Packages for farmers, for instance, include those aimed at protecting nests of meadow birds or at creating foraging areas for wintering geese. Some of these packages are especially relevant for purposes of this paper because they include connectivity measures, such as those aimed at botanical meadows (no use of pesticides, limited grazing, etc.) and at high natural-value flora meadowlands.

For other private landowners, subsidies under the SNL are aimed at preserving the specific habitat type or cultural landscape that exists on their lands. These include various types of marshes, dunes or grasslands, or cultural landscape elements like hedgerows, lanes of old trees, etc. ▶

In the Netherlands, there is also a a specific subsidy programme for the conversion of agricultural and semi-natural lands into nature areas (*Subsidieregeling Kwaliteitsimpuls Natuur en Landschap*) (SKNL). This programme applies to farmers who wish to convert their agricultural land into nature (in which case they apply for a subsidy to cover for the loss of economic productivity from these lands). It also applies to landowners who want to enhance the quality of their natural lands. This programme is especially relevant to connectivity as it provides financial incentives to convert into natural areas lands that form an essential corridor between protected areas.

Both of these programmes are currently run by local governments. Until 2011, the former programmes were executed at the national level, using national nature conservation budgets. As part of an overall plan to decentralize government policies and cut national budgets following the financial and economic crises of 2008, the current programme is executed at the provincial level with a lower budget.

Public payments for changing existing management practices. Where a semi-natural ecosystem is to be preserved to achieve connectivity conservation objectives, economic incentives can be used to encourage private landholders and resource rights holders to abandon voluntarily existing management practices or land uses that have an adverse impact on connectivity. If one landholder refuses to cooperate, this can result in a gap in a connectivity corridor which undermines its purpose. In these circumstances, significant financial incentives are likely to be required to counter the temptation of economic benefits and to induce landholders to enter into agreements voluntarily (see section 3.2.4, above, on existing uses and section 3.4, above, on voluntary conservation agreements). 473

Incentives include, for example, payments to set aside land from agricultural production or the suppression of inheritance rates on semi-natural forests, in order to take away the incentive to plant fast-growing exotic trees. Payments might be made to compensate for lost production or reduced land value ('opportunity costs' in economic literature). 474

The likely need for compensation to be paid where connectivity conservation objectives require modification of current land use, even in a relatively minor way, is illustrated by an example from Kenya. Under the wildlife conservation lease programme run jointly by the government conservation agency and NGOs, Masaai cattle farmers are paid financial incentives from donated funds to allow zebra and wildebeest to cross land owned by them during their annual migration. Those who join the programme receive compensation for any livestock lost to predators. They also receive a fixed annual payment (Bennett and Mulongoy 2006, p. 78) (Bennett and Mulongoy, 2006). 475

Public payments and incentives for implementing active management for connectivity conservation. In addition to changing existing harmful land management practices, if conservation connectivity objectives are to be achieved, it will be crucial to create conditions for maintenance of healthy ecosystems, regeneration of degraded ecosystems (for example, removing invasive plants) and active restoration or even recreation of natural habitats or species populations. In undisturbed semi-natural ecosystems, like species-rich grasslands, ongoing active management to deal with such things as unwanted forest growth, water level management or fire management will be needed. Economic instruments, in the form of public payments to landholders committed to carry out these management activities, may be the only realistic option when it comes to their cooperation over the long-term. Requiring them, through direct regulation, to carry out active management will alienate them. 476

Payments can be delivered to landholders in a number of different ways. In section 3.4, above, voluntary conservation agreements between landholders and public authorities were discussed. Landholders may be provided with significant payments as an economic incentive to enter into such agreements. Some authors include such incentives in the category of 'payments for ecosystem services' in a broad sense (Pirard and Braughton, 2011). 477

478 Direct payments under the terms of the agreement may be supplemented by tax incentives. For example, under NSW legislation, land subject to a conservation agreement is not subject to local government rates (*Local Government Act*, 1993, s. 555(1)(b1)). Under Australian Commonwealth legislation, where an agreement results in a decline in market value of the land over $5000, an income tax deduction can be claimed, provided that the agreement is perpetual and no money or other material benefit has been received for entering into it (*Income Tax Assessment Act*, 1997, s. 31.5). In addition, Australian farmers can claim an income tax deduction of capital expenditure incurred on "land care operations" (*Income Tax Assessment Act*, 1997, ss 40.630-40.640). While this is directed at a desired activity, 'land care operations', it is not targeted through individual agreements at particular areas, for example, areas needed for connectivity conservation. It is available wherever anybody wishes to carry out land care operations. 'Land care operations' are defined narrowly to focus on preventing and remedying land degradation rather than nature conservation. However, the subsidized activities may advance nature conservation indirectly, for example, by helping to pay for pest and weed control, or fencing to exclude animals from an area affected by land degradation.

479 In the USA, income, gift and estate tax deductions provide incentives for landowners to donate conservation easements, a common term for voluntary conservation agreements in that country (McLaughlin, 2004). As discussed earlier, the conservation easement has been given a special legal definition in the United States and is one of the most common forms of contract entered into by landholders to record voluntary conservation commitments that will 'run with the land'.

480 **EU Common Agricultural Policy incentive instruments.** In Europe, incentives for connectivity conservation have been integrated into a more comprehensive subsidy scheme, aiming at supporting farmers' incomes without excessive impact on biodiversity. For decades, the EU Common Agricultural Policy (CAP) has been the source of subsidies for farmers to increase farm efficiency and food production in general (not specifically aimed at, for instance, biodiversity conservation or any other specific goal, unlike individual contracts discussed above). Although this has been a success in the sense that both of these goals have been achieved, negative consequences were felt as well: distorted food markets, surplus products, and loss of biodiversity on agricultural lands. As a consequence, the CAP was reformed in 1999, 2003 and 2009 in order to cut price support and replace it by direct payments to farmers.

481 Progressively payments were dissociated from production (first CAP pillar, Regulation (EC) no. 73/2009). These direct payments, vital to most farmers, are contingent on landholder compliance with environmental legislation and good farming practices ("cross-compliance"). In parallel, an ambitious rural development policy was put in place and co-funded by the EU and Member States (second CAP pillar, Regulation (EC) no. 1698/2005). It aims at changing farm structures in order to achieve, among other things, environmental goals in the rural landscape. This policy has given birth to various types of conservation payment schemes in all Member States, including agro-environmental payments and financial support to preserve the "rural heritage". Member States have to implement the rural development policy through "rural development programmes", subject to environmental assessment and public participation.

482 The most ambitious type of payment in the CAP rural development policy is undoubtedly the agro-environment payment. Favouring voluntary action rather than coercion, agro-environmental measures consist of financial assistance provided to farmers who undertake voluntarily, for a fixed period, environmentally friendly commitments exceeding mandatory standards and good agricultural practices, in order to compensate both for their loss of income and the resulting implementation costs.

All Member States must set up an agro-environmental scheme on their territory, aimed at biodiversity conservation among other things, and fuelled by a significant part of the total budget allocated to rural development. Payments may be made through individual contracts, unilateral subsidies or public procurement. Controls in the field and sanctions are to be organized by Member States through a complex "integrated management and control system". Many types of commitments may be funded under this scheme, including conservation practices with high added value for biodiversity and connectivity. For instance, the Walloon Region of Belgium provides 450€ per hectare and per year for conservation and management of species-rich grasslands by farmers. In the Netherlands and in Flanders, payments are provided to farmers who can demonstrate that, through their commitments, selected grassland bird species successfully bred on their lands. 483

A new CAP reform is currently underway. It will introduce new instruments, especially in relation to the first pillar. In November 2010, the European Commission published a Communication on "The Common Agricultural Policy (CAP) towards 2020" (COM (2010) 672). On 12 October 2011, the Commission presented a set of legal proposals designed to make the future CAP more effective and to enhance its contribution to the Europe 2020 strategy, including its strategy on biodiversity. 484

The aim is to strengthen the competitiveness and sustainability of agriculture and maintain its presence in all regions in order to guarantee European citizens healthy and quality food production, to preserve the environment and to help develop rural areas. All suggested options require changes in present CAP instruments. In relation to market policy (the first pillar), all payments are still subject to cross-compliance (see above). However, the funding mechanism of the new CAP requires a review of the way direct payments are distributed. The Commission is proposing to spend 30% of direct payments (called 'green payments') specifically on agricultural practices beneficial to climate change and the environment, for example, through crop diversification, maintenance of permanent pasture, and the preservation of environmental reservoirs and landscapes. This will presumably involve a move towards delivering incentives through individual voluntary agreements that focus on the particular attributes of specific areas of land. 485

As for the future of rural development policy (second pillar), the new CAP proposals suggest that investments should lift both economic and environmental performance. Furthermore, environmental measures should be more closely linked to the specific needs of regions and even local areas such as Natura 2000 and agricultural areas that have a High Natural Value (HNV areas). Agri-environment-climate payments and organic farming will receive increased support. Approval of the different regulations and implementing acts is expected by the end of 2013, after a debate in the European Parliament and the Council. Ultimately, the CAP reform should be complete by January 2014 (COM (2010) 672). 486

Payments for ecosystem services. Recently, a particular type of economic instrument has been receiving increased attention from both public authorities and private stakeholders in relation to the management of land and water, namely 'payments for ecosystem services' (PES). These are defined in the strict sense, as "contractual payments based on conditionality for the provision of ecosystem services" (Pirard & Braughton, 2011) The proposed beneficiary of an ecosystem service enters into contracts with landholders in order to foster land uses compatible with the production of that service. For example, the company Vittel (Nestlé Waters) developed a PES scheme with 26 farmers in the French Vosges to reduce the nitrate levels of water associated with maize cultivation and intensive cattle grazing. Agreements for a duration of 18 to 30 years have been concluded with the farmers concerned, whereby they commit to cattle rearing without the use of chemical fertilizers or pesticides, and to investing in certain ecofriendly technological solutions, in return for the payment of an amount of about 200 €/ha/year and the allocation of a sum of about €150,000 per farm for investments (Perrot- 487

Maître, 2006). The entire surface of the water catchment close to the source has been covered by these agreements. The scheme took a decade to design and the transaction costs were very high. Consequently, schemes of this type are only conceivable when a single dominant recipient gets important benefits from the ecosystem, which is far from being the case in all connectivity conservation contexts.

488 In other PES schemes public authorities pay landholders to maintain or restore socially-desirable land uses, compatible with the production of ecosystem services (Pirard & Braughton, 2011). Under this scenario, the government passes the cost of these incentives onto users of services or to the broader community. The pioneering Costa Rican "Pago por servicios ambientales" (PSA) programme is a good example. It was established in 1997 based on existing subsidies for sustainable forestry. Costa Rican Forest Law explicitly recognizes four environmental services provided by forest ecosystems: (i) mitigation of greenhouse gas emissions; (ii) hydrological services, including provision of water for human consumption, irrigation, and energy production; (iii) biodiversity conservation; and (iv) provision of scenic beauty for recreation and ecotourism. Identified users are charged according to the nature of the service used (Pagiola, 2006). Through a sustainable management plan for their forest plots monitored by the contracting agencies, landholders commit to various types of sustainable practice: timber plantations, forest conservation and agroforestry. The system is financed both by voluntary payments by beneficiaries of the services, and by mandatory payments, such as an increase in the water tariff and a fuel tax. These payments feed a 'National Fund for Forest Financing' (Fondo Nacional de Financiamento Forestal: FONAFIFO), a semi-autonomous agency with independent legal status in charge of arranging for the payments to landholders (Pagiola, 2006).

489 It is difficult to assess the effectiveness and efficiency of the Costa Rican programme, as other measures (including a ban on deforestation) have also contributed to reducing pressures on forests by landowners. So far as biodiversity conservation is concerned, a scientific assessment (Tattenbach et al., 2006) estimated that the PSA Program prevented the loss of 72,000 ha of forests in biodiversity priority areas between 1999 and 2005. However, according to the literature, the programme still suffers many weaknesses. These include the lack of targeting, the use of undifferentiated payments, the lack of data on the extent to which its activities are, in fact, generating environmental services and difficulty in ensuring continuous funding in the long term (Pagiola, 2006). These flaws need to be corrected if the programme is to achieve its full potential.

490 Nevertheless, PES schemes represent a powerful tool for convincing landholders to turn to compatible land uses. They foster active management of land and water resources and they can be used to complement land use restrictions imposed by direct regulation.

3.5.2 Direct funding for connectivity conservation projects – The EU LIFE programme

In very fragmented landscapes, more ambitious interventions are needed in the field in order not only to preserve and manage but to restore or recreate connectivity conservation areas. Direct funding for specific conservation or restoration projects, under strict conditions, may be a strong stimulus to a connectivity conservation policy. 491

Probably the most extensive scheme for projects like this exists in the EU. In 1992, as a response to severe biodiversity loss and environmental degradation, the EU started the LIFE programme. LIFE is the EU's most important financial instrument supporting environmental and nature conservation projects throughout the EU, and also in some neighbouring countries. It is considered already to have made a significant contribution to strengthening green infrastructure. Green infrastructure in this programme is an extension of the ecological network concept. It is defined as "a network of green areas and features in rural and urban landscapes, which can enhance the resilience of species and ecosystems in adapting to climate change while securing multiple benefits for biodiversity and humans and ensuring the provision of ecosystem goods and services" (Ecologic Institute, 2011). The importance of green infrastructure has been emphasized in the EU 2020 Biodiversity Strategy by including it as one of its six targets (COM 244, 2010). 492

Each year the European Commission launches a call for LIFE+ project proposals. In order for a proposal to be considered for co-financing by the EU and Member States, it must be eligible under one of the programme's three components: 1) LIFE+ Nature and Biodiversity, 2) LIFE+ Environment Policy and Governance, and 3) LIFE+ Information and Communication. In addition, the proposal must satisfy a number of other specified criteria. Any public or private body, actors or institutions registered in the European Union can enter the programme. This includes, for example, individual farmers, farmers or other landowners joined together in an association of any kind, NGOs, and local governments. Project proposals can be either national or transnational. 493

LIFE+ (Nature and Bodiversity) may co-finance various kinds of measures, including management planning, active management, land purchase and monitoring. However, compensation for restrictions imposed on property rights cannot be funded. The applicants must submit their proposals through the Member State's competent national authority, which will forward project proposals to the European Commission. After the Commission has registered the project, the special body which is responsible for evaluation and revision of proposals, will confirm whether it is eligible, and will propose to the LIFE+ Committee a list of projects recommended for cofinancing. If the Committee gives a favourable opinion, the Commission will decide upon a list of projects to be co-financed within the limits of the funds available. Usually, the co-financing is a maximum of fifty per cent of the total project cost, although this may be raised to seventy-five per cent in the case of LIFE+ Nature proposals which focus on conservation actions for priority species or habitat types of the Birds and Habitats Directives. Finally, if the European Parliament approves the project, individual grant agreements can be signed. 494

Since 1992, LIFE has co-financed some 3104 projects across the EU, contributing approximately €2.2 billion to the protection of the environment. The current phase of the LIFE+ programme runs from 2007-2013 and has a budget of € 2,143 billion, from which at least 78 per cent must be used for project action grants, that is LIFE+ projects (Regulation (EC) no. 614/2007). 495

LIFE was a key instrument for funding green infrastructure initiatives, even before a coherent strategy on green infrastructure had been developed. LIFE+ Nature and Biodiversity projects and LIFE+ Environment projects have already shown how successful they can be in assisting the construction 496

of green infrastructure. Two concrete examples of such initiatives which LIFE programmes have co-funded are:

- **Conservation of Atlantic salmon in Scotland** (CASS project, 2004-2008). The objective of the programme is to protect and contribute to the recovery of salmon, which were disappearing due to migration problems. The actions that have been taken include the removal of 25 obstacles to migration. This has allowed salmon to access spawning grounds in the river system, which had been inaccessible before. The LIFE programme contributed € 2,347,908 in this 4 year project (LIFE04 NAT/GB/000250, CASS).
- **Corridors for Cantabrian Brown Bear Conservation** (Corredores oso project, 2009-2011). The overall objective is to contribute to the recovery of the brown bear in the Cantabrian Mountains by promoting connectivity between isolated bear populations. This was done by supporting local councils and the public living in the inter-populated corridor area to undertake bear conservation and habitat enhancement measures, and by reducing threats such as illegal snares and poisoning in the inter- population corridor. The total LIFE contribution into this project programme is € 825,000 (LIFE07 NAT/E/000735).

497 Ultimately the experiences of LIFE projects will provide support for future policy and funding for green infrastructure initiatives. However, as recognised in the EC Report, *LIFE building up Europe's green infrastructure: addressing connectivity and enhancing ecosystem functions* (EC, 2010), in order to achieve a sustainable improvement of EU green infrastructure, funding sources other than LIFE need to be identified.

3.5.3 Market creation

498 This section deals with the creation by governments of private sector markets that advance nature conservation objectives. The first step that a government needs to take to create a new market is to clarify property rights so that buyers know precisely what they are buying and have a guarantee that it will continue to exist over the long-term. In the climate change context, for example, legislation can facilitate the creation of precisely defined *forest credits* or *carbon sequestration rights* based on the amount of carbon stored in forests. This is relevant in the context of connectivity conservation because of the potential for these rights to be configured so that they advance not only climate change mitigation objectives, but also nature conservation objectives.

499 A further step that governments can take in developing a market is to create a demand from potential purchasers for these products. Again, in the climate change context a demand for carbon sequestration rights can be created by setting up a greenhouse gas emissions trading scheme which allows polluters to purchase carbon sequestration rights to offset their emissions, as an alternative to purchasing pollution permits.

500 **Conservation banking.** In conservation banking (also known as habitat banking and biobanking), legislation sets up a process that enables private landholders to create clearly defined *biodiversity credits* based on active conservation management actions on their land to enhance its biodiversity values, and sets out arrangements for guaranteeing their long-term security. These credits can then be sold.

501 Market demand for biodiversity credits is created primarily by using direct regulation to require those carrying out development to offset the damage caused to biodiversity values, that is, to compensate for the damage (for a discussion of offsets, see section 3.3.3, above). Developers may do this by purchasing biodiversity credits from those who have had them legally recognised. By linking conservation banking

with offsetting, a significant incentive is provided for some landholders to commit to invest in managing their land as a conservation banking site for a certain price. Instead of government having to provide incentives for conservation management on private land, developers pay.

Conservation banking is an example of an economic instrument being used in combination with direct regulation. In addition, apart from developers purchasing biodiversity credits as offsets, there is an expectation that conservation groups and others will enter the market as buyers once sellers exist and long-term security of the conservation banking sites is guaranteed by legislative arrangements. If appropriately configured, conservation banking can lead to the strategic location of offsets on large areas, as contrasted with the retention of small isolated fragments on the development site. It therefore has considerable potential as a tool for achieving connectivity. 502

Ideally, in conservation banking a bank of credits should be created in advance of demand for offsets, with biodiversity gains through active management already in place. In practice, it may be difficult to induce many landholders to invest in conservation management of a site without any guarantee that they will be able to find a buyer. Under the NSW scheme, discussed in Box II(3)-21 below, there is nothing to prevent the Director-General from creating a credit which can be transferred before required management actions are in place. This undermines the notion of a *bank* where credits are deposited. 503

Box II(3)-21: Conservation banking (biobanking) in New South Wales

In New South Wales, conservation banking (called 'biobanking') is authorised under the NSW *Threatened Species Conservation Act* 1995. The first step, is for a landholder to enter into a 'biobanking agreement' with the Minister to create a 'biobank site' on the landholder's land. The agreement specifies the biodiversity credits that will be created when the landholder carries out particular management actions which will improve biodiversity on the site. These credits can be sold, for example, to those who are required to offset harm to biodiversity values caused by development (see Box II(3)-15 above). The number of credits is determined by applying a scientific approach called the *BioBanking Assessment Methodology*. Once registered, conservation banking agreements run with the land, generally in perpetuity, and can therefore be enforced against future purchasers of biobank sites (see section 3.4).

The State government is primarily responsible for compliance by the landholder with management obligations under the biobanking agreement. The Minister may direct the owner of a biobank site to take action to rectify breaches and, if there is no satisfactory response, may arrange for the actions to be carried out at the site owner's expense. The Minister may bring proceedings in the Land and Environment Court to remedy or restrain a breach of an agreement and this may include an award of damages where the breach was intentional, reckless or negligent. Such an order for the biobank site is transferrable to a future landholder. In addition, any person can bring proceedings in the Land and Environment Court to remedy or restrain a breach of an agreement, but excluding the remedies of damages and transfer.

When landholders sell biodiversity credits generated under biobanking agreements, they are required to pay from the sale price into a Trust Fund an amount equal to the total present value of the estimated cost of the required management actions. This provides some assurance that there will be funding available to support the required management actions into the future, even if the land changes hands. However, landholders will expect to be paid more than this bare minimum, both to provide themselves with a profit and to cover risks that they will bear concerning whether the investment returns from the Trust Fund will be sufficient to fund future management requirements. Landholders also bear the risk of damage caused to the site by natural disasters such as fire and flood.

Tradable development rights (TDRs). TDRs represent another attempt to create a market in order to protect areas of high conservation value on privately owned land. Here, however, development credits, not conservation credits, are traded by landowners whose property is subject to a protection status or protective zoning to other landowners (who have the right to develop their lands which are in non-protected zones). This economic instrument allows the landowner whose property is in a protected status to be compensated for losses due to restrictive zoning. The first step with TDRs is for government to prohibit or significantly restrict development in an area through zoning provisions. Landowners are then compensated for their putative losses by being allowed to sell their lost development rights to landholders in another zone. These landowners are then allowed to rely on the transferred rights to 504

intensify the development of their land beyond the limits otherwise permitted in that zone. The area with development restrictions is called the 'sending area' and the area receiving the development rights is called the 'receiving area' (Williams 2004).

505 TDR schemes are extensively used in the USA, most commonly to manage urban growth. A significant factor motivating these schemes seems likely to be the takings clause in the 5th Amendment to the US Constitution, requiring compensation to be paid by government in some circumstances where development is restricted through land use regulation.

506 In other jurisdictions, government recognition of development *rights* over land, implicit in TDR schemes, would represent a significant concession. However, a TDR scheme may be an attractive alternative given the likely reluctance of governments to rezone the sending area from development to conservation where this is necessary to protect it, without providing compensation (see section 3.2.2).

507 **Comparing TDRs with offsets.** TDR schemes appear to offer significant advantages over schemes that simply require the impacts of development to be offset. Under a TDR scheme, development on a site of conservation significance is prevented, whereas it is allowed under an offsetting scheme. Offsetting schemes are more sympathetic to the wishes of those land owners who want to develop a particular site rather than being compensated for not being allowed to do so.

508 TDR schemes, therefore, secure land with high conservation value from development, whereas offsets facilitate the development of areas of conservation significance. In practice, offsetting schemes may be prepared to tolerate short-term loss of biodiversity values while degraded sites are managed as offsets to improve their biodiversity values. TDR schemes avoid the scientific uncertainty associated with offsetting.

509 Governments will often, however, be wary of acknowledging the existence of development rights required by TDR schemes because of the repercussions that this might have beyond the issue of protecting areas of high conservation significance. In general, governments vigorously resist any suggestion that they should compensate landholders for restricting land use. However, with appropriate zoning arrangements in the receiving area under a TDR scheme, governments can arrange for compensation to be paid by developers, at no financial cost to themselves.

510 There is, however, one significant drawback to a TDR scheme. Landholders retain their land but are compensated for lost development expectations. There is no incentive provided for them to actively manage their land for nature conservation over the long-term. Indeed, their defeated developmental expectations may lead to alienation and poor land management.

511 **Linking connectivity to emissions trading.** In several countries around the world, including all of the EU Member States and New Zealand, the main instrument in climate change policy is an Emissions Trading Scheme (ETS) (where a limit, or 'cap', on certain types of emissions or pollutions is set, and companies are permitted to sell, or 'trade', the unused portion of their limits to other companies to comply). Under these 'cap and trade' schemes, an overall limit is specified for greenhouse gas emissions, and this is then divided into shares which are allocated or sold to emitters as permits. Those wanting to exceed their allotted allocation must purchase additional permits from those able to reduce their emissions.

512 The EU ETS is the largest multi-national greenhouse gas emissions trading scheme in the world. It encompasses all 27 EU member states. Currently, about 40% of greenhouse gas emissions in the EU are governed by the EU ETS. An ETS is an economic instrument that does not have spatial implications and thus does not stimulate connectivity in itself. However, there has been some discussion about the

option of connecting forestry, especially forestry projects under the UN REDD programme, to the EU ETS by allowing greenhouse gas emitters to purchase forest credits (based on carbon sequestration) as an alternative to emission permits. This could be used to stimulate forestry connectivity measures.

As discussed in Part I, section 2, the REDD Programme of the UNFCCC is the United Nations Collaborative initiative on **R**educing **E**missions from **D**eforestation and forest **D**egradation (REDD) in developing countries. It was launched in September 2008 in order to address the fact that 20% of anthropogenic greenhouse gas emissions stem from tropical deforestation (Denman et al., 2007) and that the goal of combating global climate change will be impossible to achieve without reducing emissions from the forest sector. The REDD Programme seeks to build consensus and knowledge about REDD+, an effort to create a financial value for the carbon stored in forests, offering incentives for developing countries to reduce emissions from forested lands and invest in low-carbon paths to sustainable development. Ultimately, the Programme aims to include a REDD+ mechanism into a post-2012 climate change agreement. 513

As a response, the European Commission on 17 October 2008 released a Communication on Deforestation (COM 645/3, 2008). This communication set an objective of halting global forest cover loss by 2030 at the latest, and reducing gross tropical deforestation by at least 50% by 2020 compared to current levels. Reaching this goal, according to EC estimations, will require between €15 and €25 billion per annum. 514

The EU ETS is the basic economic instrument on climate change mitigation in Europe. In this light, the logical way to find these funds in Europe would be through the EU ETS, by allowing greenhouse gas emitters to purchase avoided deforestation credits created under REDD+ as an alternative to pollution permits. The European Commission recently, however, decided that recognition of forest credits in the ETS at the present time is not realistic. This is explained by the fact that emissions from deforestation are almost three times higher than the amount of emissions regulated under the EU ETS. As the EU ETS is currently the only major operational trading system in the world, allowing companies to buy avoided deforestation credits would result in serious imbalances between supply and demand in the scheme. As a result, the European Commission proposed to exclude forest credits from the EU ETS until at least 2020. After that, linking REDD+ to the EU ETS might still be a feasible alternative, but several issues, such as the conditions under which forest credits can be used in the ETS, and monitoring and compliance conditions have to be resolved. 515

Key messages

Economic instruments provide an additional tool to support connectivity conservation actions by landholders. Economic instruments introduce the element of choice. They use negative and positive price signals (for example, charges and incentives) to encourage landholders to change their behavior, while direct regulation requires compliance. 516

Some economic instruments, like taxes and charges, are designed to remedy failures in the market place by making those carrying out activities pay for any harmful side-effects ('negative externalities'). Other economic instruments, such as management payments to landholders, respond to market failure by paying for the benefits the community receives from private activities ('positive externalities'). 517

While economic instruments are often presented as alternatives to direct regulation, in practice they are frequently used in combination. Direct regulation has an important role to play in protecting existing areas from proposed development where it is incompatible with connectivity conservation, but will be less effective for imposing 'active management' obligations for connectivity conservation purposes (for 518

example, to implement traditional agricultural or forestry practices and restoration projects). In these circumstances, positive economic incentives, for example, in the form of management payments, may be the best tool for convincing private landholders and rightsholders to voluntarily contribute to the connectivity conservation management effort. However, in some cases landholders may choose to initiate active management practices on their lands or with their resources completely on a voluntary basis for ethical or cultural reasons. Even in these cases, supportive economic incentives may encourage them to make greater investments in long-term active management than might otherwise have been the case.

519 Payment for ecosystem services (PES) is another tool for providing positive economic incentives for voluntary conservation action by landholders which has been receiving increased attention from both public authorities and private stakeholders in relation to management of land and water. PES is a contractual arrangement where a landholder agrees to provide and sustain certain ecosystem services through land uses that are compatible with the production of those services (for example, protecting a watershed for its water resources) and in return the beneficiary promises to pay an agreed amount for that service for an extended duration. While PES is a promising new economic tool, it presents some of its own challenges from the limited experience to date. These relate, for example, to ensuring continuous funding in the long term and being able to verify that the tool is in fact generating the desired environmental services and ecological objectives.

520 One of the most effective ways to restore connectivity areas consists in governments directly injecting public funds, under strict conditions, to support large-scale restoration projects on private lands. Advocates of connectivity conservation can draw on extensive experience of the successful use of management payments in this context, for example, in the EU LIFE+ programme.

521 Market schemes artificially create property rights based on certain defined values and these rights can then be bought and sold. As a tool for connectivity conservation, there is less experience with market-oriented tools than with other economic instruments. An emerging market-oriented tool being recognized in some legal systems is ‘conservation banking’, a mechanism which allows private landholders to create conservation credits through active conservation management actions on their land to enhance its biodiversity values, and sets out arrangements for guaranteeing the long-term security of those credits. But conservation banking is still in the experimental stage. In addition, many are concerned about the link that is made between conservation banking and biodiversity offsetting (discussed above in Part II, section 3.3.3) with a view to creating a market demand for biodiversity credits. This concern stems from the scientifically controversial idea that biodiversity offsets can ensure that there is “no net loss” of biodiversity resulting from development.

522 Tradable development rights represent another attempt to create a market in order to protect areas of high conservation value on privately owned land. They avoid the need to offset because development on a site of conservation significance is prevented, with the ‘right’ to develop that site transferred elsewhere. However, there is no automatic mechanism for ensuring that the protected site is actively managed.

4 Special issues for Marine Connectivity

Introduction

On a global scale, the health of marine and coastal ecosystems is declining and being increasingly threatened by overlapping and, in many cases, cumulative impacts such as overfishing, pollution, invasive species, coastal development, and climate change. This section considers several issues and concepts specific to marine environments and marine connectivity conservation that need to be taken into account in legal instruments and approaches for connectivity in marine and coastal areas. The section builds on and should be read together with Part I of this paper on general science and management principles for connectivity conservation, and Part 2 on the many legal tools and approaches that have elements important for connectivity conservation in general. The discussion generally follows the order of these prior Parts to help with cross-references and integration, as relevant. 523

The section also builds on and draws from the *IUCN Guidelines for Protected Areas Legislation* (Lausche, 2011), and specifically the marine chapter which discusses special legal considerations for marine protected areas (MPAs), including connectivity (see Part III, Ch. 2 of those Guidelines). As with all prior sections of this paper, the term 'connectivity conservation' is used in relation to natural connectivity needs of formal protected areas, in this case, MPAs and MPA networks. Also, the phrase 'marine protected areas' is used to include coastal protected areas, unless the context provides otherwise. 524

The section divides the discussion on special issues for marine connectivity into three broad topics: science issues, management issues, and legal issues. The science topic begins with a brief review of definitions for marine connectivity. In that context, the discussion reviews major biophysical features of marine environments that present special challenges when translating scientific understandings into legal tools. It also explores how some landscape ecology concepts may be useful for seascapes and how marine connectivity relates to climate change adaptation and mitigation. 525

Next, the management discussion turns to tools for spatial area management in marine environments where connectivity is an inherent component. Three management approaches are reviewed: MPA networks, marine ecosystem-based management, and area-based marine management (tools as marine spatial planning, ocean zoning, and integrated coastal and ocean management). 526

The third topic, legal issues, begins with an overview of selected international law instruments at global and regional levels that are particularly relevant for marine connectivity conservation, starting with the United Nations Convention on the Law of the Sea. Drawing from the marine science and management discussions, the section closes with several points of a legal nature important to take into account when strengthening or updating national/subnational legal frameworks to address the special connectivity needs of MPAs and MPA networks. 527

4.1 Defining marine connectivity

The discussion of what is marine connectivity conservation must begin by noting that connectivity research in marine systems is in its infancy, and is much less advanced than for terrestrial systems (Dibacco et al., 2006, p. 204). Advances in such technologies as remote sensing, Geographic Information Systems (GIS), satellite imaging, and tagging methods are helping scientists improve their ability to collect and analyze the data needed for connectivity in marine systems. This is helping increase awareness about the severe decline in coastal and marine ecosystems and fisheries stocks worldwide. Yet, only limited data are now available on the connectivity of marine species (Sale et 528

al., 2010). One of the greatest scientific challenges for defining marine connectivity conservation in practical terms is unravelling the linkages among different patterns and behaviours of marine life and their interaction with such complex and dynamic factors as different seafloor characteristics, water masses (Arctic, North Atlantic, North Pacific, deep water, etc.), ocean currents, and ocean density (temperature, salinity, and pressure) (Dibacco et al., 2006, p. 204).

529 As with terrestrial areas, connectivity for marine and coastal areas can be understood as four main types: seascape connectivity, habitat connectivity, ecological connectivity and evolutionary process connectivity. With the exception that the focus is mostly on the seascape in the case of marine connectivity instead of on the landscape, the general descriptions to these types in Part I, section 1, Table I(1)-2 above apply equally to marine environments. For purposes of marine conservation, seascapes have been defined as –

> large, multiple-use marine areas, defined scientifically and strategically, in which government authorities, private organizations, and other stakeholders cooperate to conserve the diversity and abundance of marine life and to promote human well-being (Conservation International, 2009, p. 2).

530 There are four key ways that natural connectivity occurs in MPA networks and across marine environments through which marine species and ecosystems interact and function:

- Connections of adjacent or continuous habitats such as coral reefs and seagrass beds, or among mangrove and seagrass nursery areas and coral reefs.
- Connections through regular larval dispersal in the water column between and within MPA sites.
- Regular settlement of larvae from one MPA to another MPA that promotes population sustainability.
- Movements of mature marine life in their home range from one site to another or because of regular or random spillover effects from MPAs. (IUCN-WCPA, 2008, p. 52)

531 The use of MPAs and MPA networks is a starting point for connectivity conservation management because some connectivity is achieved de facto when marine reserves are established, even though it is unlikely that connectivity will be optimal (Dibacco et al., 2006, p. 201). Moreover, from a scientific perspective, marine connectivity conservation should be a critical component in design of such areas and networks (Sale et al., 2010). There is a growing body of management guidance in the literature elaborating on the application of marine connectivity conservation in light of existing and emerging scientific knowledge about marine natural connectivity. This literature is helpful for understanding elements of legal capacity needed for marine connectivity conservation management.

532 IUCN-WCPA published guidance in 2008 on connectivity and MPA networks. Entitled *Establishing Resilient Marine Protected Area Networks – Making it Happen*, this publication presents five core ecological guidelines, one of which is 'ensuring ecological linkages'. Specifically, "MPA network design should seek to maximize and enhance the linkages among individual MPAs and groups of MPAs within a given network" (IUCN-WCPA, 2008, Guideline 4).

533 Particularly helpful from the legal perspective, the publication defines 'connectivity' for marine systems:

> connectivity describes the extent to which populations in different parts of a species' range are linked by the exchange of eggs, larvae recruits or other propagules, juveniles or adults (IUCN-WCPA, 2008, p. 52).

534 Another publication, released in 2010 and supported by the United Nations University, World Bank/ Global Environment Facility, University of Queensland, and others, focusses on connectivity of coral reefs. Entitled *Preserving Reef Connectivity: A Handbook for Marine Protected Area Managers*, this handbook defines connectivity as:

> the flux of items between location types that are the same or different (for example, reefs and/or seagrass beds). It exists for nutrients, sediments, pollutants, and individual dispersing organizations, i.e., any item that has the potential to move among and between reefs and other environments (Sale et al., 2010, p. 8).

With respect to coral reefs, the literature elaborates on connectivity in terms of what is needed for effective transfer of organisms among populations and identifies two forms of population connectivity (Sale et al., 2010): 535

1) Evolutionary (genetic) connectivity: the amount of gene flow occurring among populations over a timescale of several generations. It determines the extent of genetic differences among populations.
2) Demographic (ecological) connectivity: an exchange of individuals among local populations that can influence population demographics and dynamics. It can include:
   - Exchange of offspring between populations through larval dispersal;
   - Recruitment of juveniles and survival of these juveniles to reproductive age;
   - Any large-scale movement of juveniles and adults between locations.

4.2 Scientific understandings and management approaches

In the field of marine science and management, professionals have long known of the critical role connectivity plays for sustaining marine and coastal habitats (coral reefs, seagrass, mangroves, etc.) and marine biodiversity. As with terrestrial biodiversity, marine biodiversity is decreasing due to a wide range of stresses, particularly from overfishing and habitat loss, along with new stresses from climate change. The traditional strategy for protecting marine biodiversity against existing stresses has been the use of marine protected areas. However, studies confirm that even well-managed marine protected areas are constrained in their ability to protect biodiversity from such outside threats because normal MPA management programmes have no or limited authority control activities outside the designated MPA boundaries. 536

Further constraining the effectiveness of well-managed MPAs is the fact that the life history of many marine species involves travelling through many different environments where they may be vulnerable to factors other than harvesting and habitat loss. For example, many coastal habitats, such as estuaries and mangroves, provide critical nursery habitat for organisms that spend most of their lives further offshore. But these coastal habitats are disappearing due to such factors as sea level rise, eutrophication, coastal development and sedimentation. Marine scientists, conservation managers and some policy makers recognize the need to promote and apply an ecosystem approach to marine planning and management for all marine activities (Ehler and Douvere, 2010; Foley et al., 2010; MEAM, 2011). For decades, scientists have understood ecosystem-based management as an approach that takes into account the relationships among all ecosystem components, both human and nonhuman. In the past decade, this approach has drawn attention from policy-makers. The concept was advocated, for example, by the Pew Oceans Commission in its 2003 report, *America's Living Oceans: Charting a Course for Sea Change,* and by the U.S. Commission on Ocean Policy in its 2004 report, *An Ocean Blueprint for the 21st Century.* 537

4.2.1 Science

538 The unique natural features of and threats to marine environments, including climate change, present special challenges when designing or strengthening legal instruments for marine connectivity conservation as part of marine and coastal resource planning, conservation, and sustainable use. These challenges include reflecting the connectivity features between the land and the sea and exploring how landscape ecology concepts for connectivity and the lessons learned may be relevant for seascapes. These issues are discussed in this review of science considerations.

539 **Special natural features of marine environments.** Scientific understanding of the special nature and interactive behaviour of marine ecosystems and marine life has advanced in recent decades. As laid out in the *IUCN Protected Areas Legislation Guidelines* (Part III, Chapter 2 of those guidelines), several special characteristics and features of marine environments need to be taken into account in legislation on marine conservation, and these are particularly important when considering connectivity. Key features include the following:

- **Three-dimensional space**: ocean processes function in three-dimensions: the ocean floor, water column (vertical space), and horizontal movement at different depth of species and processes. In general marine life is less dependent on the ocean floor than terrestrial organisms are on the land surface.
- **Ocean processes are highly complex and dynamic:** ocean processes transport nutrients, food, seeds, larvae and organisms, as well as pollutants, across vast ocean and land ocean areas. These processes are highly dynamic and subject to natural changes, sometimes rapid, without regard to political boundaries, including national jurisdictions or boundaries of MPAs.
- **High environmental vulnerability:** The oceans, coasts, species, and processes contain are fluid and dynamic by nature. This results in high environmental variability both temporally and spatially, making living marine resources and marine ecosystems particularly complex to analyse in movement and structure. Marine systems have been much less studied than terrestrial systems. There is less scientific certainty about how they function to sustain marine life and ecosystem processes, the critical relationships between marine species and processes, and the long-term effects of multiple stresses and threats to their sustainability.
- **New challenges for deep-water, off-shore ocean areas:** such as deep ocean processes, sea mounts, hydrothermal vents and cold water corals, support marine ecosystems and a diversity of life never known before. These systems are particularly vulnerable and need special protections, even though there may be less scientific data to inform decisions. New technologies are giving humans the capacity for deeper exploitation of these frontiers for harvesting and mining, including deep water oil drilling (and damage from accidents such as the BP Deep Horizon Oil Spill in 2010 in the Gulf of Mexico), bottom trawling, and other human activities.
- **Marine and land processes are connected:** there is high natural connectivity between freshwater, coastal and marine systems. The life history of many marine species involves movement through many different environments, for example, from rivers, tidal streams, coastal beaches and mangroves to far offshore. This precludes the effective management of a marine species and marine habitat protection independent of its adjoining coastal and inland areas, including coastal estuaries, wetlands, streams and connected watersheds. Land-based sources of marine pollution are a broadly shared threat to marine systems worldwide and may originate at great distances from the resulting impact (for example, the Great Pacific Garbage Patch). This strong land-sea connection has implications for the design of marine and coastal connectivity conservation areas and management plans which need to be reflected in the legal tools developed to support those areas and plans.

- **Off-shore deepwater marine connectivity:** natural systems connectivity is even more complex in large-scale offshore deepwater marine environments because in such areas, ocean currents, wind drifts, and species migrations create natural linkages between distant regions of the ocean. To begin to address these special properties of the marine environment, the large marine ecosystem (LME) approach can be used to aid marine ecosystem-based management and conservation in areas of the ocean characterized by distinct depths, hydrology, productivity and food-web interactions.
- **Vast marine areas within national jurisdiction:** most coastal states have declared a 200 nautical mile exclusive economic zone (EEZ). For many coastal states, this designation extends the marine area under national jurisdiction to cover an area larger than the entire land area, and in small coastal or island states, many times larger.
- **Special threats:** Scientific research and monitoring of the health of the world's coasts and marine ecosystems and species continues to inform managers and policy makers about the deteriorating state of the world's oceans and growing threats to marine ecosystems and species. The most significant existing threats have been coastal degradation, habitat destruction, overfishing and land-based sources of pollution. Today, climate change is adding new stresses on the coastal and ocean environment, further threatening marine biodiversity and ecosystems in significant ways. The most important of these are changes in ocean temperature, changes in ocean current patterns, sea level rise, and ocean acidification (Craig 2012).
- **Scientific uncertainty:** marine systems have not been as thoroughly studied as terrestrial systems and much of the marine life and biodiversity of the oceans is yet to be discovered and described (Census 2010). Marine science experts, however, have long urged that uncertainty should not stop efforts to define ecologically important areas needing marine protection (Kelleher, 1999). In such decision making, however, it is imperative that the precautionary approach needs to be applied to decision making about marine conservation and management so as to prevent or minimize adverse impacts now and into the future.

Connectivity between land and sea through coastal ecosystems. Connectivity conservation important for MPAs and MPA networks requires attention to their wider coastal and marine environment. The coastal zone is where biophysical interactions between the land and the sea are strongest (Post and Lundin, p. 3). Particularly when considering MPAs in coastal or near-shore areas, an essential component of the scientific analyses is the connectivity role of the coastal zone and linkages that extend from the watersheds to the sea. These interactions are dynamic, as explained in marine management literature, because coastal areas – 540

- contain both land and ocean components;
- have land and ocean boundaries that are determined by the degree of influence of the land on the ocean and the ocean on the land; and
- are constantly changing in width, depth, and height (Kay and Adler, 2005, p. 3).

Many human activities along coastal zones have impacts on MPAs. Coastal degradation, which is already a major threat to marine biodiversity and ecosystems, could grow significantly and accelerate in the years ahead, according to the *Millennium Ecosystem Assessment Report* 2005, as coastal populations increase. (MEA, 2005:1). UNEP estimates that coastal density, which is directly correlated to degradation, is expected to increase as a global average from a present density of 77 people per square kilometre to 115 people per square kilometre by 2025 (UNEP 2012). 541

For marine biodiversity and marine ecosystems, the threat from pollution is also mostly from coastal zones due to wastewater discharged into the sea and agricultural run-off. Over loading of such nutrients 542

may cause eutrophication, harmful algal blooms (including blooms of toxic species) and sometimes the formation of oxygen-depletion zones (dead zones) that kill most marine animal life. Coastal pollution does not only affect near-shore marine biodiversity. Through sea currents and wind, coastal pollution and debris travel to offshore ecosystems, such as coral reefs, that may be virtually continents away. Sedimentation from coastal development and deforestation along rivers and watersheds, and from the destruction of mangroves and other coastal vegetation, adds further stresses to coastal and marine systems. These threats impact MPAs both directly and also indirectly when ecosystem functions and species critical to the purposes of the MPAs are harmed outside the MPAs.

543 Coastal/marine linkages require that MPAs be designed and managed in the context of their broader coastal and ocean environments. By the 1990s, this was a major recommendation of IUCN in one of WCPA's first best practice guidelines, *Guidelines for Marine Protected Areas*, as follows:

> MPAs are essential for marine conservation. However, the seas will only be conserved effectively by integrated management regimes that deal with all the human activities that affect marine life (Kelleher, 1999, p. 1).

544 In 2004, the IUCN/WCPA published nine principles and supporting guidelines for incorporating marine protected areas into integrated coastal and ocean management and governance frameworks (Ehler and Cicin-Sam, 2004). The first principle addresses connectivity, as follows:

> Connectivity between the terrestrial and marine side of the coastal area and between MPAs and the surrounding coastal and marine area should be recognized and maintained. To this end, a good scientific understanding of the ecological, socioeconomic, and cultural linkages and connectivity between ecosystems and humans in the coastal zone has to be developed. This is essential for ensuring that management of MPAs and the wider coastal and marine area is well integrated (p. 7).

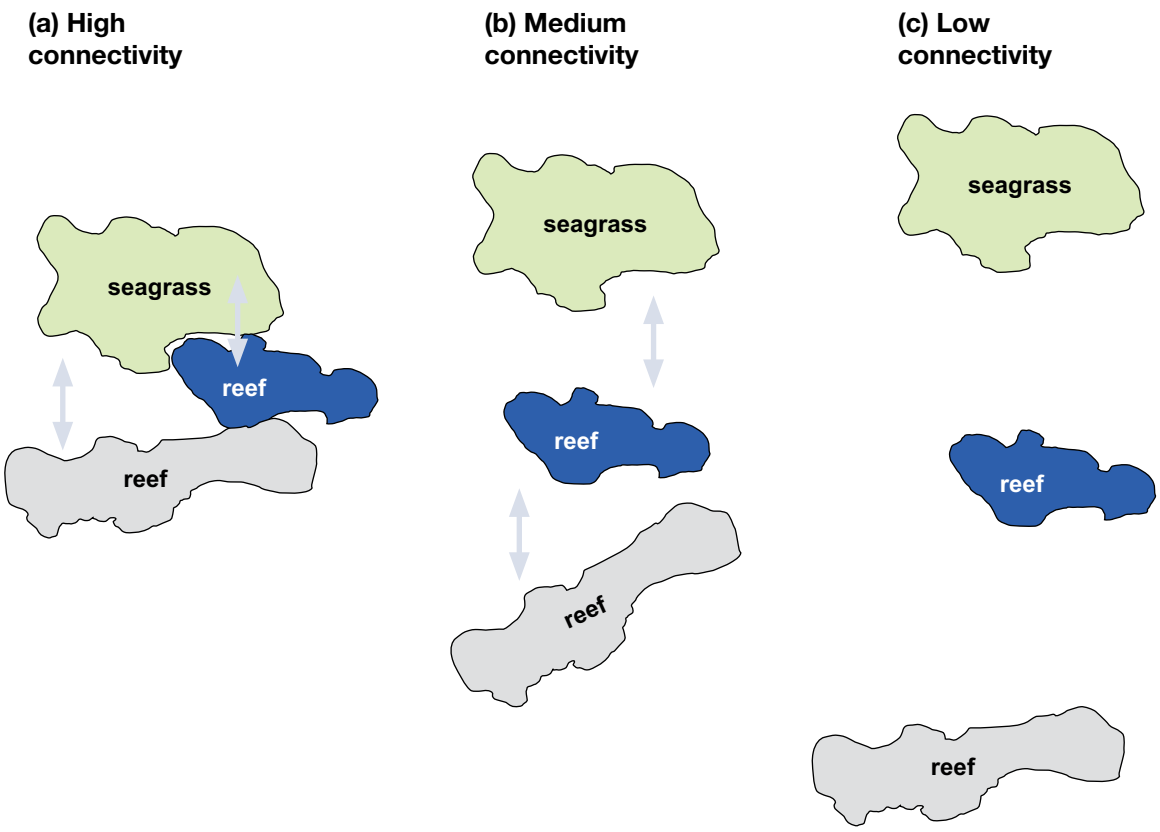
545 Small island states are a prime example where virtually all life on the land has immediate connections to the sea. Economic, social, political, and resource management systems have been directly developed and defined by these connections, with ecosystem and community-based natural resource management becoming important supportive concepts. Particularly in light of the special vulnerability of small islands to climate change effects such as sea level rise and extreme events, national legislative initiatives for islands also are recognizing the importance of natural connectivity conservation for MPAs and MPA networks as part of building resilience and ecosystem-based adaptation to climate change (see Boer and Clarke, 2012, for their work in the Pacific Islands).

546 **Applying landscape ecology to seascapes.** Lessons being learned in terrestrial environments about landscape configurations and connectivity also are useful for marine connectivity (Grober-Dunsmore et al., 2009). While there are still many gaps, scientific understanding about marine life and connectivity has improved, especially about fish and crustaceans in tropical waters and in the strong linkages of different life cycle phases to the ocean floor, certain water depths or certain habitat types. Landscape ecology concepts have begun to be applied to connectivity conservation in coastal and marine ecosystems (Pittman et al., 2011; Goodsell and Underwood, 2009; Grober-Dunsmore et al., 2009). Canada, for example, has used connectivity concepts such as 'patch', 'stepping stones', and 'corridor' in its science-based guidelines for MPAs and MPA networks (Chan et al., 2011). Applying landscape ecology elements to seascape connectivity provides a framework for determining the amount, type, configuration, and location of patch types required for maintaining marine ecological connectivity, and therefore needing some form of protection or restoration (Grober-Dunsmore et al., 2009, p. 523). Figure II(4)-1 below illustrates how different types of marine patches might be used to support connectivity.

547 Several landscape ecology concepts are relevant for seascape connectivity. These include spatial scale of patches, proximity of specific patch types, fragmentation, habitat composition, specific habitats for certain organisms, and large scale connectivity. Issues of scale are a fundamental consideration given

the dynamic and three-dimensional nature of marine space and marine ecosystem functions. Large scale disturbances (such as over-harvesting, large-scale contamination) need different strategies to protect marine resources at risk than small-scale disturbances (such as point-source contamination). Corridors for many marine habitats are likely to be currents that transport fertilized eggs and larvae among isolated populations or an aggregation of patches could form a corridor connecting larger habitat areas.

Figure II(4)-1: Representations of seascape patches and connectivity



Source: Grober-Dunsmore et al., p. 499 (Fig. 14.2).

In coral reef ecosystems a wide variety of patch types have already been classified (for example, linear reef, patch reef, seagrass, sand, etc.). Table II(4)-1 illustrates some of the main concepts in landscape ecology that may be applied to coral reef ecosystems. These concepts also are important to consider when designing legal instruments for marine connectivity planning, implementation and enforcement. 548

Table II(4)-1: Definitions in landscape ecology applied to seascapes

Concept	Definition	Coral reef example
Matrix	Dominant element in a landscape	Sand or seagrass
Patches	The basic spatial element in the landscape	Reef patch
Mosaic	Combination of different patch types usually interspersed amongst one another	Patches of seagrass, reef, sand, mangrove

Seascape	A heterogeneous marine area that can exist at wide range of scales and may be described as a mosaic pattern or spatial gradient	The home range of a fish is an ecologically meaningful seascape
Patch context	The position of a patch relative to surrounding seascape elements	A patch may be surrounded by seagrass or sand habitat
Seascape connectivity	The degree to which the seascape facilitates or impedes movement among resource patches	Cross-shelf movement of medium-sized tropical marine food fishes
Stepping stone connectivity	A row of small patches (stepping stones) can connect an otherwise disconnected set of patches	Seagrass patch connecting reef patches in sand matrix
Source: Adapted from Grober-Dunsmore, 2009, table on p. 497 which was adapted from Forman, 1995.		

549 **Climate change and the marine environment.** Marine scientists and marine resource managers consider climate change to be one of the most challenging issues and serious threats facing MPAs and the marine environment today and that these challenges will increase in the foreseeable future (Day, 2006, p. 628). Climate change is already impacting marine ecosystems and species. Marine and coastal ecosystems are among the most vulnerable to climate change and many already are showing signs of impacts, most of them negative. Ongoing climate change research indicates that the majority of marine ecosystems on the planet are changing rapidly (Hoegh-Guldberg and Bruno, 2010). Among the most significant changes for marine systems are increasing global ocean surface temperatures, rising sea levels, more extreme weather events (for example, changing precipitation patterns, coastal storms, storm surges), and changing ocean and wind circulation patterns. In addition, the oceans (which already are the largest carbon sink on Earth) are continuing to absorb excess CO_2 which is lowering ocean pH and increasing acidity of the surface layers (ocean acidification). This impact represents a major departure from the geochemical conditions that have prevailed in the global ocean for hundreds of thousands if not millions of years, and could diminish the abundance of microscope plants and animals that build calcium carbonate structures (Hoegh-Guldberg and Bruno, 2010; Kennedy et al., 2002).

550 These changes will have increasingly serious effects on both coastal and ocean ecosystems and their biodiversity. The impacts recorded so far include decreased ocean productivity, altered food web dynamics, reduced abundance of habitat-forming species, shifting species distribution, reduced sea ice, and a greater incidence of disease (Hoegh-Guldberg and Bruno, 2010). Coastal ecosystems have been better studied than the open ocean. Thus, studies in the early 2000s were already stressing that climate changes would have significant effect on those systems, especially estuaries and coral reefs, which are relatively shallow and currently under stress from human population growth and coastal development (Kennedy et al., 2002).

551 Studies indicate that among the most clear and profound impacts from climate change on marine systems will be on habitat-forming species such as corals, sea grass, mangroves, salt marsh grasses, and oysters (Hoegh-Guldberg and Bruno, 2010). This is a critical issue for biodiversity conservation and for selecting connectivity conservation areas because collectively these organisms form the habitat for thousands of other species. As explained in one article, “although some resident species may not have absolute requirements for these habitats, many do, and they disappear if the habitat is removed. For example, mass coral bleaching and mortality, the result of increasing temperatures, is already reducing the richness and density of coral reef fishes and other organisms” (Hoegh-Guldberg and Bruno, 2010, p. 1524). While impacts are already being identified, however, many more site- and species-specific

changes are presently difficult to predict and will depend in part on the rate of changes as well as the extent of changes.

Apart from habitat changes, many species in both coastal and ocean waters are sensitive to temperatures just a few degrees higher than those they usually experience in nature, affecting mortality and geographic distributions. Many mobile species may be able to adjust their ranges over time, but less mobile species may not, leaving them to adjust to new predators, prey, parasites, diseases, and competitors. This includes fisheries which will be affected and some species lost from a region as others arrive. Canada is an example of a country where these impacts on MPA connectivity are already being recognized in 2011 Science-based Guidelines for Marine Protected Areas and MPA Networks. These guidelines explain that that warmer sea temperatures will speed up larval development time, resulting in shorter dispersal distance for organisms with a larvae stage and a possible breakdown of connectivity among MPAs located at current dispersal distances, and as a consequence propose more, closely-spaced MPAs rather than fewer, widely-separated MPAs in order to preserve connectivity in the face of this impact from climate change (Jessen et al., 2011). 552

These kinds of climate change adaptation considerations due to ecological shifts in marine environments already present major challenges for managers and policy makers. Connectivity conservation will be an important tool for adaptation so long as management plans and policy directives on marine conservation and connectivity take into account the likelihood of major ecological shifts as changes from climate occur. 553

There is growing scientific evidence that well-designed and managed marine connectivity conservation areas also could play a role in climate change mitigation (see Laffoley and Grimsditch, 2009). Many coastal ecosystems are good at sequestering carbon and are located in areas where management could help with their protection for carbon storage. Among the most important are tidal salt marshes, mangroves, seagrass meadows, and kelp forests. From a scientific perspective, these areas should be priority targets for conservation and sustainable use management regimes. Where connectivity conservation is a component of management regimes for such areas, it is important to consider measures that benefit both climate adaptation and mitigation. 554

4.2.2 Management

The spatial scale over which marine connectivity occurs may be very large (Dudley, 2008, p. 55). MPAs are an indispensable tool for sites of high biodiversity or ecosystem value. On a continuum of spatial area management, connectivity tools are needed to incorporate MPAs and MPA networks into their larger coastal and marine area management frameworks, as explained earlier. This discussion on management considerations reviews three management approaches or concepts that aim to contribute to this goal. They are 1) MPA networks, 2) marine ecosystem-based management and 3) area-based marine management (such as marine spatial planning, ocean zoning, and integrated coastal and ocean management). 555

MPA networks. MPAs and MPA networks provide the context within which marine connectivity conservation needs are identified and addressed in concrete terms, just as terrestrial protected areas and protected area systems are the context for terrestrial connectivity conservation. The term ‘network’ is commonly used when discussing marine protected areas. The term ‘system’ is most commonly used with terrestrial protected areas, although ‘network’ is being used more as well, for example in CBD decisions on protected areas in relation to ecological networks (for example, 10th COP, Dec. X/31). In some countries, the term ‘system’ is used for the overall programme, for example, national parks 556

system, but this usage does not necessarily imply connectivity. Also, protected areas may be created on the basis of representativeness but still not be linked from an ecological point of view. 'Network' is used here to indicate natural connectivity.

557 Depending on the country or jurisdiction, various terms may be used for marine protected areas, including marine reserves, marine management areas, no-take reserves, and coastal and marine management areas. While the term 'marine protected area' is considered a specialized protected area for marine or coastal environments, IUCN guidelines provide that such areas should meet the IUCN definition for all protected areas, as noted in Part II above. In addition, IUCN has developed a specialized definition for MPAs, as follows:

> any area of intertidal or subtidal terrain, together with its overlying water and associated flora, fauna, historical and cultural features, which has been reserved by law or other effective means to protect part of all of the enclosed environment (Kelleher, 1999).

558 Setting aside marine areas for protection has traditionally been used to replenish fisheries. In the 1980s, MPAs began to be recognized for their value to marine biodiversity conservation. Following the terrestrial protected areas approach, the idea of networks of MPAs also took hold as a better strategy to better protect and restore marine biodiversity than could be possible with single, isolated MPAs. One single sufficiently large MPA for this purpose also was not feasible in most regions of the world.

559 Connectivity is inherent in the MPA network concept (IUCN-WCPA, 2008). In 2003, the World Parks Congress called on the international community establish "a global system of effectively managed, representative networks of marine and coastal protected areas, consistent with international law and based on scientific information" (WPC Rec. V.22). IUCN/WCPA defines an MPA network as follows:

> a collection of individual MPAs or reserves operating cooperatively and synergistically at various spatial scales, and with a range of protection levels that are designed to meet objectives that a single reserve cannot achieve. (IUCN-WCPA, 2008, p. 12)

560 Today, almost all countries recognize the MPA network approach as a valuable management tool for conserving marine biodiversity and biological connectivity, enhancing fisheries, protecting marine ecosystems, and building resilience in the face of climate change. In addition, the approach has become a more acceptable way to help reduce socioeconomic impacts from conservation measures without compromising overall marine biodiversity conservation and sustainable resource use goals (IUCN/WCPA, 2008). The global community continues to emphasize the importance of establishing a global system of marine and coastal protected area. Decisions on marine and coastal biodiversity adopted by the 10th Conference of the Parties to the CBD in 2010 reiterated this goal, not only to support marine and coastal biodiversity but also to build resilience to climate change and play a critical role in climate change mitigation and adaptation (Decision X/29).

561 **Ecosystem-based marine management.** For decades, scientists have recognized the need to make decisions about the use, protection and management of marine and coastal resources taking an ecosystem-based approach. This approach takes into account the cumulative impacts of different sectors affecting the marine or coastal ecosystem and includes the total ecosystem, including the human community (IUCN, 2008: 15). As noted earlier, policy makers also are increasingly endorsing this approach at the international level, for example, through CBD guidance, as well as in national ocean policy instruments.

562 For ecosystem-based management to work, MPA networks formed through the scaling up of individual MPAs should be designed and integrated into the broader ecosystems of which they are a part. The geographical extent of protection should be based on the movements of organisms and physically linked processes (IUCN, 2008:15). The concept of ecosystem-based management is increasingly

being incorporated in conservation and sustainable resource use legislation and in policies of resource management agencies. It is a valuable approach for assessing marine and coastal connectivity conservation because it requires consideration of the multiple components of a scientifically-defined area in order to recognize the linkages between those components.

Translating and implementing the concept through concrete actions on the ground, however, continues 563
to present challenges. For example, case studies of eight United States coastal and marine sites examined the degree to which the ecosystem-based management concept was incorporated into management plans and actions. The studies found that very few of the cases addressed ecological linkages between ecosystem components or the operation of ecosystems over a wide range of spatial and temporal scales (Joint Ocean Commission Initiative, 2007, p. 22). To help guide scientific research and implementation of marine ecosystem-based management, a U.S. Joint Ocean Commission produced An Agenda for Action in 2007 that includes key principles for marine ecosystem-based management (see http://www.jointoceancommission.org). These principles were endorsed by both the U.S. Commission on Ocean Policy and the Pew Oceans Commissions, the two commissions that make up the Joint Ocean Commission, and a 2005 scientific consensus statement on marine ecosystem-based management signed by 221 academic scientists and policy experts.

These principles require attention to connectivity and provide insights worth considering in law and 564
policy instruments for marine connectivity conservation. They are as follows:

- **Base the delineation of management areas on ecosystems** in order to align decision-making with the complex issues that may affect many parts of an ecosystem.
- **Focus on overall ecosystem health** to ensure that the long-term provision of a full range of services essential to the well-being of people and other living things is a higher priority than short-term economic or social goals of individual sectors or interests.
- **Consider the cumulative impacts** of different activities on the ecosystem, including the diversity and interactions of species.
- **Recognize connectivity** among and within ecosystems by accounting for the import and export of larvae, nutrients, and food.
- **Respond to uncertainty with precaution** such that the less that is known about a system, the more precautionary management decisions are, and that activities proceed only when there is evidence that ecosystem functioning will not be harmed.
- **Coordinate at scales appropriate to specific goals** including between and among oceans, coasts, and watersheds, and at local, regional, national, and international levels.
- **Restore and protect** native biodiversity to strengthen resilience to both natural and human-induced changes.
- **Develop indicators** to measure the status of ecosystem function and services and to gauge the effectiveness of management efforts.
- **Acquire more and better science for decision making** by reorienting research and monitoring to match ecosystem boundaries, develop better tools to communicate and apply information, and invest in social science, ocean science, engineering, exploration, observation, and infrastructure.
- **Engage stakeholders and the public** through transparent and participatory processes.
- **Provide for adaptive management** that improves future decision making through continual information gathering, periodic assessments, and modification of plans and actions (italics added) (Joint Commission Initiative, 2007: 21-22)

565 **Area-based marine management approach.** Area-based marine management is a concept that is generally understood to consist of a defined marine area in which to apply planning, zoning, and other marine resource management and governance tools. This concept provides a geographic framework for ecosystem-based management and incorporating MPAs and MPA networks. While the idea is relatively new without much practical application, marine science and policy literature includes several articles exploring definitions and principles for different approaches to area-based marine management. The concept also embraces a variety of terms. The discussion below looks at three applications of area-based marine management: marine spatial planning, ocean zoning, and integrated coastal and ocean management.

566 **Marine spatial planning.** Marine spatial planning (MSP) is generally defined to mean the public process of analysing, planning, and allocating the spatial and temporal distribution of human activities in marine areas to achieve certain ecological, economic and social objectives that are usually specified through a political process (MEAN, 2011). The broad goal is to achieve the well-being and long-term sustainability of ocean ecosystems in order to maintain essential ecosystem services for human populations (Foley et al., 2010). To achieve this goal, connectivity conservation is an essential component.

567 Marine scientists emphasize that translating MSP from theory into practice is not an easy process for several reasons. As noted earlier, when compared to terrestrial environments, there are many more gaps in scientific information about how marine ecosystems work and relate, as well as the total number of species and kinds of life in the oceans. In addition, from a governance perspective, in most coastal and marine areas there are already many existing uses, such as MPAs; artisanal, sport, and industrial fishing; recreation; habitat for endangered marine species, harbours and ports; mineral extraction; and scientific research. These uses are generally overseen by sector laws and agencies. Anticipated uses also need to be taken into account because marine ecosystems are dynamic, human needs change, and climate change impacts will increasingly require adaptation. Anticipated uses may include setting up wind and other renewable energy facilities, designating new fishing grounds, developing aquaculture, licensing bio-prospecting, or adjusting conservation and use zones for climate change adaptation and mitigation.

568 As a new tool for marine management, ecological principles to guide MSP are only beginning to emerge. For example, in 2010, The Center for Ocean Solutions (a consortium of the Words Institute at Stanford University, the Monterey Bay Aquarium, and the Monterey Bay Aquarium Research Institute) convened a workshop of fifteen eminent U.S. scientists to produce a list of ecological principles or guiding concepts that could be used to meet the goals and objectives of ecosystem-based MSP. The group identified four basic principles, including connectivity, all of which are worth considering in legal instruments on MSP (Roley et al., 2010, p. 5). These ecological principles are:

- maintain native species diversity,
- maintain habitat diversity and heterogeneity,
- maintain populations of key species, and
- maintain *connectivity* (emphasis added).

569 In elaborating on these ecological principles, the group considered connectivity and native species diversity to be most commonly identified as essential for maintaining functioning marine ecosystems (Foley, 2010, p. 3).

570 While application of MSP is still in its infancy, some countries are applying the approach and international organizations are acknowledging it as an emerging tool for achieving marine ecosystem-based management (Ehler and Douvere, 2010). Policy makers in several countries have begun to

consider MSP as a viable strategy to spatially manage current and emerging human uses of coastal and marine waters. Examples of countries where MSP initiatives are underway include the United Kingdom, Belgium, Canada, Norway, Netherlands, Germany, China, the United States, Australia and, at a regional scale, the European Union (MEAN 2011; Foley et al., 2010)). To date, many of these efforts have had a relatively limited scope focused on certain existing uses, while others have explicitly addressed multiple sectors**.** The common element appears to be its growing acceptance as a planning tool to help make informed decisions about marine conservation and sustainable use. (See Box II(3)-3 for the approach in the United States.)

Early lessons from country experiences highlight five elements that are critical for a successful MSP process (Ehler and Douvere, 2010). They also are considered to be core elements for an effective MSP governance framework. These elements are: 571

authority to require all agencies to comply with the approved marine spatial plan, authority may come from existing legislation, new legislation, or other legislative mechanisms;

broad participation, meaning all key stakeholders must be involved because MSP aims to achieve multiple objectives (social, economic, and ecological) and different stakeholders reflect these interests. This requires multiple and targeted public sessions, interviews, surveys, and other means to ensure participation;

ecosystem-based planning such that the final plans reflect ecosystem patterns and processes at appropriate spatial and temporal scales and address fundamental topographic, oceanographic, and ecological conditions enabling identification and protection of the most ecologically and economically valuable places;

integrated planning to address multiple objectives and integrate a wide range of uses and issues, in particular, integrating economic activities with nature conservation objectives; in addition, integration means consistency across state, federal-state, and international boundaries;

future-oriented and adaptive scope because it is important to focus on the future since MSP is most useful as a dynamic process anticipating changes in the future, not only programming based on the past. This is essential to be prepared for such global change factors as climate change and significant increases in human populations. It means preparing alternative spatial sea use scenarios to take into account such factors using the best scientific projections available on sea level rise and other climate change impacts and how these impacts may require additional or different ocean allocations for sand extraction and other adaptive responses.

Box II(4)1: Marine Spatial Planning in the United States

On July 19, 2010, U.S. President Obama signed an Executive Order establishing a National Policy for the Stewardship of the Oceans, Coasts and Great Lakes. Among other things, this policy provided for the development of regional coastal and marine spatial plans for all coastal areas and the Great Lakes to –

> enable a more integrated, comprehensive, ecosystem-based, flexible and proactive approach to planning and managing sustainable multiple uses across sectors and to improve the conservation of the ocean, our coasts, and the Grate Lakes (EO 13547, sec. 1).

Pursuant to this policy, the United States has been divided into nine planning areas for which marine spatial plans are being developed. The seaward geographic scope of the marine spatial planning areas is the territorial sea, the exclusive economic zone, and the continental shelf. The landward scope is to the mean high-water line, including inland bays and estuaries. Activities that occur beyond the EEZ would be considered in the plans if they potentially affect resources or human activities within the planning areas.

Implementation of that policy is underway. The mandate calls for cooperative planning among federal , state, tribal and local governments with substantial stakeholder and public participation. The current phase includes engaging specific stakeholder groups, including those associated with ocean industries and the conservation community to seek common ground related to marine spatial planning. Another initiative is organizing a series of training workshops on coastal and marine spatial planning. These workshops are intended to provide a high-quality curriculum for use by professional coastal managers, enhanced regional modules based on surveys in each region, collaborative activities, and incentives for continued education and networking. ▶

> The overall goal of this coastal and marine spatial planning framework is to provide, for the first time, a science-based and transparent road map for coastal communities to directly, objectively, and inclusively plan the future in their waters. As explained on the NOAA Coastal and Marine Spatial Planning web site, the framework is intended to support –
>
> > regional planning processes in which those who are most familiar with, and most affected by, the region's ocean and coasts are empowered and given the data, tools, and responsibility to make informed decisions about how their waters are to be used for this and future generations.
>
> *Source: drawn from text of Executive Order 13547, NOAA web site http://www.cmsp.noaa.gov, and Ehler and Douvere, 2010.*

572 There are differing views on the long-term potential of MSP to protect and sustain ocean ecosystems at a time of fast growing uses and increasing demand. As a planning tool, MSP requires the cooperation of many users and government agencies with significant interests and authority over different coastal and marine uses, operating frequently through overlapping, conflicting, and uncoordinated sector-specific laws. MSP does not, in itself, provide the policy and legal framework to require implementation. These limitations were characterized recently by the Ocean Foundation, an international NGO.

573 MSP is a tool that produces maps of how we use the oceans; attempting through coordinated effort among agencies to track how the ocean is being used and what habitat and natural resources remain at any given time. The hope of MSP is to bring together ocean users – avoiding conflicts while keeping the ecosystem intact. But MSP is not a governance strategy. It does not produce a unified ocean policy nor resolve conflicting agency priorities and statutory contradictions that increase the potential for disaster (Spalding, 2011).

574 In terms of legal effect, the marine management literature generally differentiates MSP from ocean zoning (discussed next), with the former being mainly a planning tool and the later mainly a regulatory one (MEAN, 2011).

575 **Ocean zoning** is another area-based marine management strategy that is related to marine spatial planning, but different. In the scientific and management literature, the two concepts are clearly differentiated (Agardy, 2011). MSP is viewed as a public process to understand and plan ocean uses, resulting in a broad plan. Ocean zoning may give effect to that plan through regulatory tools.

576 Ocean zoning commonly has a zoning map or maps on which to base the regulations for some or all areas of the marine space being considered. MSP initiatives may result in zoning maps, but such maps are only one aspect of the plan. It's broader purpose is provide a forward-looking framework for existing and anticipated uses of coastal and marine space in order to achieve ecological, social, and economic objectives. Undertaking ecosystem-based MSP for the explicit purpose of ocean zoning is a relatively new idea. In general, MSP has stopped short of applying regulations for lack of political, economic, and social support as well as for the enforcement challenges involved.

577 With ocean zoning, marine scientists and conservationists stress that zoning regulations should not be built only on existing uses, but also should anticipate future uses and scenarios, including for a changing climate (Craig, 2001). While circumstances and planning processes will vary, marine conservationists urge that for ocean zoning to effectively achieve MSP objectives three steps are integral to the process:

- Understanding (and mapping) existing patterns of use and impacts;
- Identifying (and mapping) ecologically critical and sensitive areas; and
- Developing multiple zoning options with scenarios that show costs and benefits of each.

Integrated coastal and ocean management. The coastal zone is the discrete area of interaction between the land and the sea, as discussed in Part I. Recognizing this interaction and associated connections, scientists are increasingly urging that MPAs and MPA networks be part of integrated coastal and ocean management governance frameworks in order to better address such broad-based threats as climate change, and provide buffers against localized threats (Ehler and Cicin-Sain, 2004). Based on country surveys, a recent World Bank concluded that the concept of integrated coastal management is "the only framework that can begin to address externalities at scales large enough to buffer Marine Protected Areas and other [coastal and marine management] areas from lethal threats beyond their control" (World Bank, 2006, p. xiii). 578

It has long been recognized by resource managers that governance of hydrologic systems for their water resources and environmental flows (as discussed in section 3.1 of Part II, above) should be sufficiently coordinated and integrated to reflect the physical reality that these systems are connected from the watershed to the sea. As a practical matter, administrative limits of different sectors and political jurisdictions in many countries define how watersheds, coastal areas, and marine waters are to be managed and by whom, which may create a legal framework of sector-specific laws and overlapping institutions and jurisdictions driven by singular single interests (for example, urban water supply, hydropower production, recreation, agriculture, flood control, wildlife). 579

The concept of integrated coastal zone management (or integrated coastal management or integrated coastal and ocean management) has gained attention in recent decades as an area-based management tool for on-the-ground integration and coordination of the many policies, sectors, laws, interests, and administrative levels involved in the coastal zone. A distinguishing feature is that the resulting management and governance framework is inherently meant to manage the coastal zone as a whole using an ecosystem approach rather than to manage the area only sector-by-sector only. 580

By the 1970s, the concept of integrated coastal zone management was being incorporated in national legislation as a way to manage coastal growth and the multiple functions of the coastal zone (see, for example, the United States Coastal Zone Management Act of 1972). In 1992, the concept gained global stature through Agenda 21, the comprehensive action plan adopted by participants at the U.N. Conference on Environment and Development (UNCED, popularly called the Earth Summit) in Rio de Janeiro. Agenda 21 contains a distinct chapter on coastal and marine environments largely framed around the concept of integrated management and sustainable development of coastal and marine areas, with extensive policy and programme guidance to aid states and international organizations in their commitment to implement the concept (Chapter 17). 581

Today, more than 700 programmes in integrated coastal management have been initiated around the world (Ehler and Cicin-Sain, 2004). For the concept to be effective in implementation, a key aspect is a clear definition of the geographic area being covered. The common application is the coastal zone. The definition of the coastal zone will vary widely from country to country and there does not appear to be one accepted definition. The seaward extent of a coastal zone often is defined using jurisdictional or administrative limits. For example, in the United States, the Federal Coastal Zone Management Act defines the coastal zone to extend seaward to the outer limit of a state's jurisdiction. For most coastal states, such as California, the state limit has been defined by the Submerged Lands Act of 1953 to be 3 nautical miles offshore from the shoreline. 582

The dynamic nature of most coasts makes it more difficult to clearly define the landward limits of a coastal zone. The general principle is that the inland limit to the coastal zone should extend landward only to the extent necessary to control shoreline uses that may have direct and significant impacts on the coastal waters. Areas affected by or vulnerable to sea level rise also may need to be taken 583

into account. As a practical matter, the inland limit of a coastal jurisdiction may be defined by linear distances inward from the shoreline. For example, in California, this landward limit is generally defined as 1,000 yards from the mean high tide line of the sea, with exceptions to go further inland when needed to include significant coastal estuaries, habitat and recreational areas, and with exceptions to extend less than 1,000 for where developed urban areas may exist (California Coastal Act, 2010).

584 The *Millennium Ecosystem Assessment* (MEA) *Report 2005* offers a general definition of 'coastal systems', suggesting that the seaward limit go to about the middle of a country's continental shelf and that the inland limit include all areas strongly influenced by the proximity to the ocean. That MEA Report also offers another definition using, by example, specific distances seaward and inland as follows: "the expanse of a coastal system [is] … the area between 50 meters below mean sea level and 50 meters above the high tide level or extending landward to a distance 100 kilometers from shore (p. 27). Using this latter measure, the MEA has estimated that nearly half of the world's major communities (having more than 500,000 people) are located within 50 kilometres of the coast.

585 In 2004, as discussed above, the IUCN/WCPA published of guiding principles (including on connectivity) for integrated coastal and ocean management as a framework within which MPAs should be managed (Ehler and Cicin-Sain, 2004). These principles also covered governance and implementation elements important for strengthening linkages between MPAs and the wider coastal and marine area. Those governance and implementation principles are relevant for consideration in legal instruments on marine connectivity conservation. They are divided into two main themes and several principles as follows:

1) Developing governance arrangements to incorporate MPAs into the broader framework of integrated coastal and ocean management (ICOM)
   - Strengthened and more effective relationships – vertically and horizontally – are needed to allow appropriate stakeholder participation at every stage of development and implementation of MPAs, and to achieve adequate linkage of MPAs with ICOM institutional structures and planning processes.
   - MPA management should be an integral part of ICOM governance: in cases where no ICOM institutions have been put into place, MPA managers will need to relate to sectoral institutions concerned with watershed management, fisheries, tourism, maritime transportation, etc.
   - Planning of individual MPAs should be participatory and integrated within broader spatial management and economic and social development frameworks to ensure their sustainability and promote creation of functionally connected networks of MPAs.
2) Fostering implementation of MPAs through enhanced policy and management tools
   - Mobilizing adequate resources and capacity is essential for successful implementation, sustainability, and integration of MPA and ICOM programs.
   - The effectiveness of MPAs and their incorporation into ICOM frameworks has to be assessed through appropriate tools, guidelines, and trained personnel. Evaluation of MPAs should be conducted at the individual site, subnational, national, and regional levels.
   - Ecologically coherent networks of MPAs, including geological and oceanographic considerations, provide a spatial management tool to prioritize biodiversity conservation and ensure maintenance and enhancement of environmental goods and services, which are essential objectives of ICOM.

4.3 Special legal considerations

This subsection begins with a review of selected global treaties and a few regional instruments to highlight obligations and commitments in international law that countries may be able to use to support and be guided by national efforts to design legal elements supportive of marine connectivity conservation. A discussion of national legal considerations follows. Connectivity elements for marine conservation law are only beginning to receive attention, mostly as a passing reference in the scientific literature. Today almost every coastal country has at least one marine and coastal protected area and even here legal tools and techniques for MPAs are much less advanced than for terrestrial protected areas. Scientific understanding about marine biodiversity and the operation of marine ecosystems for connectivity is even less well understood. In that light, the focus of the national legal considerations is on a few broad legal issues relevant for marine connectivity conservation that can begin to guide and direct national efforts to build helpful legal support. 586

4.3.1 International marine law instruments

Sections 1 and 2 of this Part, above, reviewed several important international and regional legal instruments relevant for connectivity conservation, mostly in terrestrial environments. The discussion here looks at some of the same instruments as well as others for their application to marine environments and marine connectivity conservation and the support and guidance they may provide for designing effective legal tools at the national level. The *IUCN Guidelines for Protected Areas Legislation* provides expanded analyses of many of these instruments particularly for their relevance for protected areas in both terrestrial and marine environments, and the discussion below draws from much of that material. 587

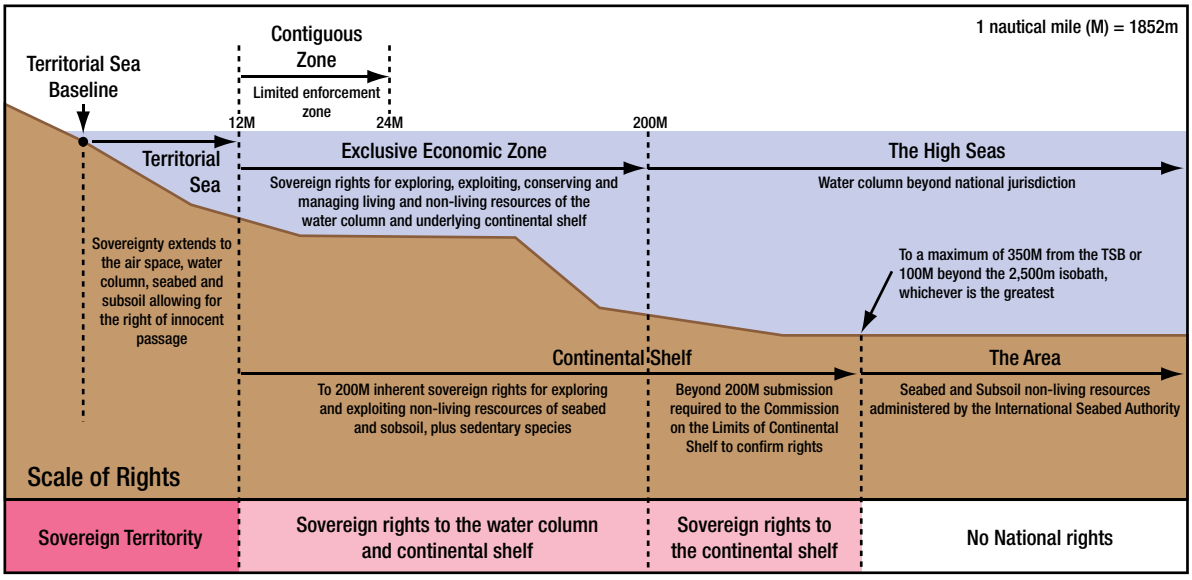
United Nations Convention on the Law of the Sea (UNCLOS). This convention serves as a unifying framework for more specific ocean law agreements and an international law foundation for the continued development of ocean law at global and regional levels. While UNCLOS does not include specific reference to marine connectivity conservation, a number of provisions set out general obligations of states that cannot be achieved without addressing natural connectivity needs. The treaty contains general objectives and principles to guide protection and sustainable use of the marine and coastal environment and its resources. It divides the ocean into zones – territorial sea, contiguous zone, exclusive economic zone (EEZ), continental shelf, and high seas. The treat defines the rights and obligations of coastal states and other nations within these zones. (The zones are explained in detail and illustrated in the *IUCN Guidelines for Protected Areas Legislation* (Lausche 2011, pp. 223-226) That discussion also includes an illustration of the various ocean zones as defined by UNCLOS and for ease of reference that illustration is reproduced here in Figure II(4)-2). 588

Most directly relevant for marine connectivity conservation, the treaty establishes an unqualified obligation on all states to protect and preserve the marine environment (Art. 192). Other provisions give more legal context to this obligation. For example, an article requires states to prevent, reduce and control pollution of the marine environment from any source, including land-based and sea-based sources (Art. 194). A related article expands this obligation to requiring conservation and management of marine living resources and the habitats and ecosystems upon which they depend by specifying that marine pollution measures “shall include those necessary to protect and preserve rare or fragile ecosystems as well as habitat of depleted, threatened or endangered species and other forms of marine life” (Art. 194(5)). 589

UNCLOS also recognizes a number of foundation principles which states should apply when exercising their rights and duties under the treaty. These principles provide further legal context and support for 590

elements to include in legal provisions for marine connectivity conservation. These principles include: science-based decision-making, environmental impact assessment ecosystem approach, prevention and precaution, and regional and global cooperation.

Figure II(4)-2: Maritime Zones under the UN Law of the Sea Convention



Source: Artic Council, 2009, p. 52.

591 **United Nations Fish Stocks Agreement.** This Agreement under UNCLOS is formally titled 'Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea of 10 December 1982 relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks' (1995). It requires states to protect biodiversity and the marine environment, and exploit and use the covered fisheries sustainably. While the Agreement's main focus is long-term sustainable use of straddling and highly migratory fish species mostly in the High Seas, some of its obligations and principles are explicitly extended to marine areas within national jurisdiction.

592 Two articles are especially relevant when a state which is Party to the agreement is considering legal provisions for marine connectivity conservation. First, the Agreement requires wide application of the precautionary approach both within and beyond national marine waters to activities aimed at conservation, management, and exploitation of straddling fish stocks and highly migratory fish stocks in order to protect the living marine resources and preserve the marine environment (Art. 6.1). Second, the agreement also explicitly requires that conservation and management measures established for the high seas and those adopted for areas under national jurisdiction be compatible in order to ensure conservation and management of the straddling fish stocks and highly migratory fish stocks in their entirety (Art. 7.2). For more detail on specific conservation and management obligations in the Agreement, the World Bank working with the FAO published in 2001 an extensive legal guide for implementing the Agreement in national legislation through sustainable fisheries legislation (Edeson et al., 2001). This guide contains many useful points for legislative provisions that are directly relevant for marine connectivity conservation.

593 **International Maritime Organization (IMO) rules and conventions.** IMO manages a number of marine environmental treaties that have relevant elements for national marine connectivity conservation. These include two legal concepts directly relevant for marine connectivity conservation. First is the

authority to designate particularly sensitive sea areas (PSSAs) that need special protections because of their ecological, socio-economic, or scientific significance and the threat of damage by international shipping activities. Once a PSSA has been approved, the IMO has special measures it can take to control maritime activities in that area, such as routing, strict application of discharge restrictions and equipment requirements for ships such as oil tankers.

Second, under the International Convention for the Prevention of Pollution from ships and its Protocol of 1978 (commonly referred to as MARPOL), special sea areas may be identified. Special areas are those which require the adoption of mandatory measures to prevent sea pollution for technical reasons relating to their oceanographic and ecological condition and to their sea traffic. Under MARPOL, special areas are provided with a higher level of protection than other areas of the sea. Guidelines for designation of special areas under MARPOL were adopted by the IMO 22nd Assembly in 2001 (IMO 2001 A.927(22)). 594

Convention on Biological Diversity (CBD). The CBD Conference of the Parties adopted a Programme of Work on Protected Areas in 2004, discussed above in section 1 of this Part. This programme contains principles, goals and actions applicable to all protected areas. In 1998, the Conference of the Parties had before it a separate programme of work for marine and coastal biodiversity, as called for in its earlier decision. In 1998 Conference of Parties adopted a separate programme of work for marine and coastal biodiversity (CBD COP 1998 IV/5) and in 2004 adopted a significantly updated programme (CBD COP 2004 VII/5). 595

The CBD Programme of Work on Marine and Coastal Biodiversity was guided by a technical report which stressed that the use of marine and coastal protected areas was a main tool for maintaining marine ecosystems in a truly natural state in response to CBD requirements to protect or restore ecosystems, natural habitats and species populations (SCBD, 2004b, p. 9). 596

The Eighth Meeting of the Conference of the Parties already had recognized that the application of tools beyond and within national jurisdiction need to be coherent, compatible and complementary (CBD COP 2006 VIII/24). The 2008 decision also urged Parties to apply these tools when establishing their networks of MPAs. Annex II of the 2008 decision provides 'Scientific Guidance for Selecting Areas to Establish a Representative Network of Marine Protected Areas, Including in Open Ocean Waters and deep-Sea Habatats'. The Annex explicitly identifies 'connectivity' as one of the five 'Required network properties and components' for selecting areas to be part of networks of marine protected areas. The guidance explains this requirement as follows: 597

- Connectivity in the design of a network allows for linkages whereby protected sites benefit from larval and/or species exchanges, and functional linkages from other network sites. In a connected network individual sites benefit one another (CBD COP 2008 IX/20, Annex II).

This international scientific guidance from the CBD Conference of the Parties provides an important explicit tool for promoting national action for legal provisions supporting marine connectivity conservation. 598

Ramsar Convention. The Ramsar Convention sets out the obligation for countries to promote the conservation of wetlands by pursuing compatible land use planning and other measures such as establishing nature reserves (as discussed in Part II-1). For countries that are Parties to the Ramsar Convention, wise land use planning is a major tool for advancing compliance with this treaty. 599

The Ramsar Convention defines wetlands to include areas "with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six metres" (Art. 1). This covers most coastal zones around the world. 600

601 In 2002, Parties to the Ramsar Convention adopted 'New Guidelines for the management planning of Ramsar sites and other wetlands'. These guidelines focus on the site-based scale of management planning, recognizing that site planning should be one element of a multi-scale approach to wise use planning and management of wetlands. The emphasis is on the need for wetland site management to be integrated with broad-scale landscape and ecosystem planning, including at the integrated river basin and coastal zone scale, because policy and planning decisions at these scales will affect the conservation and wise use of wetland sites (Ramsar COP 2002 VIII.14, Annex, para. 5, 14–27).

602 **World Heritage Convention Marine Programme.** Marine sites come within the scope of the World Heritage Convention (discussed generally in section 1, Part II, above). The Operational Guidelines for the Convention provide that listed sites may include property "representing significant ongoing ecological and biological processes in the evolution and development of terrestrial, fresh water, coastal and marine ecosystems and communities of plants and animals" (UNESCO, 2008b, para. 77).

603 Marine site have been significantly under-represented in the World Heritage List. In an effort to address this situation the World Heritage Committee in 2005 approved a World Heritage Marine Programme that would more aggressively promote the nomination of large-scale marine areas and MPA networks, including transboundary nominations (that is, nominated by more than one state). The action was intended to give increased attention to marine areas needing protection from such growing threats as overfishing, inappropriate fishing practices, coastal development and pollution. Nominations can extend all the way out to the EEZ.

604 These law and policy developments at the international level add further policy support for countries to take initiatives, using the best scientific information available, to identify and protect large-scale marine areas valuable for their biodiversity and ecosystem services. As part of the national initiative, it is important to develop (hand in hand with formal MPAs) the necessary policy and law tools to support management of marine connectivity conservation areas needed to sustain the MPAs and MPA network.

605 **CMS Agreements and Memoranda of Understandings.** The CMS (discussed generally in section 1, Part II, above) provides a mechanism for natural connectivity. Agreements and memoranda of understanding (MOU) may be concluded among states through which specific migratory animals pass to protect them and their habitat as they migrate across countries, as discussed in Section IV. In effect, the Convention is one of the first international law instruments to provide a legal framework for explicit connectivity conservation protections needed by specific migratory species of concern. The scope of such connectivity conservation protections may be transnational, continent-wide, possibly even continent-to-continent depending on the migratory range of the species.

606 Under the CMS, marine migratory animals and their habitats have been the focus of several legal instruments that protect the connectivity needs of the species of concern. These are important policy instruments that become national policy and legal commitments for protecting the specific marine species and habitat essential for their migratory patterns. Such commitments to connectivity conservation of concerned migratory species can provide a basis for addressing marine connectivity conservation in the country more generally.

607 To illustrate the growing scope of the CMS in marine connectivity conservation, some examples of migratory marine species being protected are worthwhile to note. The migratory patterns of the various species may span regions, continents, or be global in scope. Agreements have been concluded for conservation of seals in the Wadden Sea, small cetaceans of the Baltic and North Seas (ASCOBANS), cetaceans in the Black Sea, Mediterranean Sea and Contiguous Atlantic Area (ACCOBAMS), albatrosses and petrels, and African-Eurasian Migratory Waterbirds (AEWA). MOUs have been concluded to

conserve marine turtles of the Atlantic Coast of Africa, marine turtles and their habitats of the Indian Ocean and South-East Asia, cetaceans and their habitats in the Pacific Islands Region, dugongs (manatees) and their habitats throughout their range, manatees and small cetaceans of Western Africa and Macronesia, Eastern Atlantic populations of the Mediterranean monk seal, and migratory sharks (see CMS website).

4.3.2 Regional marine law instruments

Regional seas agreements. The Regional Seas Programme was launched by the UNEP in 1974 to address the accelerating degradation of the world's oceans and coastal areas through the sustainable management and use of the marine and coastal environment. It does this by engaging neighbouring countries in comprehensive and specific actions to protect their shared marine environment and by stimulating the creation of Regional Seas prescriptions for sound environmental management that are coordinated and implemented by countries sharing the common body of water. Today Regional Seas Programmes covers 18 regions of the world. Thirteen of these Programmes covering more than 143 countries have been established under the auspices of UNEP. Most Regional Seas programmes with legally binding conventions have also adopted legally-binding protocols in various areas of special concern, including oil pollution, land-based pollution, marine protected areas and marine biodiversity conservation. The protocols require national legislation for implementation. 608

These regional programmes provide another legal tool to promote national legal instruments for marine connectivity conservation. Connectivity concerns must be an essential element of any measures to support marine protected areas and sustainable management and use of the marine and coastal environments of these regions. 609

Ospar Convention. The Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR Convention) was concluded in 1992 as a cooperative mechanism to protect the marine environment of the North-East Atlantic. The European Community plus 15 states participate: Belgium, Denmark, Finland, France, Germany, Iceland, Ireland, Luxembourg, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the UK. A representative of each comprises the OSPAR Commission, the decision-making body of the Contracting Parties, which meets annually. 610

Annex V of the Convention addresses the 'Protection and Conservation of the Ecosystems and Biological Diversity of the Maritime Area'. Article 3(1)(b)(ii) makes it a duty of the Commission to "develop means, consistent with international law, for instituting protective, conservation, restorative or precautionary measures related to specific areas or sites or related to particular species or habitats." By the nature of marine environments and marine species, marine connectivity conservation must be an integral consideration in meeting this obligation. 611

The OSPAR maritime area includes the internal waters, territorial seas and EEZs of the Contracting Parties, as well as a portion of the high seas. Thus, the Convention area encompasses marine areas beyond national jurisdiction. While most OSPAR sites are also Natura 2000 sites, this broad scope of coverage beyond national waters has the potential for transnational MPAs involving marine areas both within and beyond national jurisdiction, helping build connectivity conservation areas at the transnational level between national MPA networks. 612

Natura 2000. The European Union (EU) Birds Directive (1979, as amended in 2009) and Habitats Directive (1992), which generated the Natura 2000 legal framework, has been discussed in section 2 of Part II, above. These legal instruments require Member States to establish special protection areas 613

for birds and special areas of conservation (SACs) for other species in order to maintain or restore to a favourable conservation status the natural habitat types and habitats of species of Community interest.

614 In 2005, the European Court of Justice issued a judgment finding that Member States are obliged to designate SACs in their EEZs and to provide marine species protection in that zone as laid down in the Directive. In 2007 the Commission of the European Communities issued guidelines on how to implement the Directive with respect to the EEZ. The 'Guidelines for the establishment of the Natura 2000 network in the marine environment' (European Commission, 2007), include discussion of different marine zones, legal aspects for implementing environmental legislation in the marine environment, marine habitat types, and how to locate and select marine Natura 2000 sites. This provides another legal tool at the regional level to promote national legal provisions for marine connectivity conservation.

615 Two other EU directives discussed in Section II-2.2 and related to coastal and marine conservation are important to note again here. These are the **EU Water Framework Directive**, enacted by EU members in 2000, and EU Marine Strategy Framework Directive enacted in 2008. As discussed above, the **EU Water Directive** sets out policy and law for river basin management at transnational scale to promote sustainable water use across entire river systems from the source to the sea. River 'continuity' is one of the elements noted for achieving the ecological goals of the Directive. The Marine Strategy Directive provides a framework Member States to achieve a good environmental status for their respective marine areas. Connectivity is necessarily an important element for achieving this status.

4.3.3 International marine programme – MAB Biosphere Reserves

616 UNESCO's Man and the Biosphere Programme (MAB) activities span protection, scientific research and human use for coastal marine biosphere reserves and for integrated biodiversity strategies for islands and coastal areas. These are supported by other UNESCO initiatives, such as its ecosystem-based marine spatial management initiative which aims to help countries operationalize ecosystem-based management in marine environments by finding space for biodiversity conservation and sustainable economic development of those environments. UNESCO and UNEP also have a regional seas partnership on marne and coastal protected areas designed to coordinate information related to marine and coastal protected areas and contribute to national efforts to establish representative networks of marine protected areas (see UNESCO MAP web site).

617 These initiatives aid the application of the biosphere reserve concept to marine areas under national jurisdiction. The MAB biosphere reserve programme is discussed generally in section 1.6 of Part II, above.

4.3.4 National legal considerations

618 Effective MPA networks and marine connectivity conservation areas require legal authority with clear powers, mandates, responsibilities, mechanisms for planning and coordination, incentives, funding, and enforcement. As noted at the beginning of this section, marine biodiversity and marine ecosystems, including important natural connectivity functions, are a relatively new area of scientific study, and is less well understood than terrestrial connectivity. Marine connectivity conservation is even a newer topic for law. However, in the past decade, marine scientists and policy analysts have begun to articulate policies and legal principles important for marine conservation, including marine connectivity, based on the emerging science.

It is important to begin by stressing that most coastal and island nations have some domestic legislation in marine and coastal conservation and management which can be used to begin to advance marine connectivity conservation. These laws may include generic protected areas legislation covering both terrestrial and marine areas, site-specific laws for particular marine protected areas, specific marine species protection laws (for example, for sea turtles, whales, and other marine mammals), and coastal zone management laws. Many of these laws have not been updated with modern science-based concepts for marine conservation and management. 619

Drawing from the research and analyses of marine connectivity and law reflected in this section, the discussion below offers several key points of a legal nature important to take into account when reviewing the adequacy of existing legislation or enacting new legislation for connectivity. These points also may be a helpful baseline on which to build further research, including case studies, in this emerging area of law. They are presented in no order of priority: 620

- **Maritime zones.** There are several maritime zones which MPA networks may need to occupy as part of an ecosystem-based approach, each with their own considerations as to sovereign authority and limitations, consistent with international law. MPA networks within national jurisdiction may be part of broader regional, transnational, or continental networks across zones and beyond national jurisdiction, a concept that should be recognized in domestic legislation. For legal purposes, these zones are commonly divided into – 621
  - waters within national jurisdiction: marine internal waters (coastal estuaries and other bodies affected by tides), territorial sea, exclusive economic zone, continental shelf (coastal state's rights and limitations are discussed in the *IUCN Guidelines for Protected Areas Legislation*); and
  - waters beyond national jurisdiction – high seas and the Area (defined by the Law of the Sea Convention to mean the sea-bed and ocean floor and subsoil thereof beyond the limits of national jurisdiction, and all related activities of the Area for exploration and exploitation of resources).
- **Large scale management schemes for MPAs.** To be effective, MPAs and MPA networks must be designed and operated for ecological connectivity within the context of higher-order, cross-sectoral management tools such as integrated coastal and ocean management or other comprehensive spatial or zoning frameworks. 622
- **Science-based decision making.** Science-based decision making and flexibility are important elements to emphasize in legal provisions for marine connectivity. Managing marine and coastal environments for marine connectivity must be driven by the best available scientific information about how marine and coastal ecosystems function, key natural features of and threats to marine biodiversity, and natural connectivity needs. Adaptation for climate change and actions for climate change mitigation also must be science-based. As scientific understandings improve about the functions of marine and coastal systems, threats to marine environments, and impacts from climate change, management needs flexibility to incorporate and adjust regimes based on this new knowledge. 623
- **Marine ecosystem-based management.** As with terrestrial environments, the requirement for an ecosystem-based management approach for MPAs, MPA networks, and their wider coastal and marine environments should be grounded in law. An ecosystem-based marine management approach is essential for defining effective protections for formally protected marine areas, related coastal marine management areas, needed connectivity conservation areas outside the protected areas. Overall, an ecosystem-based marine management approach aims to protect the health of 624

marine and coastal ecosystems, maintain and enhance biodiversity through marine conservation and sustainable resource use, and incorporate considerations of resilience and adaptive ability for climate change.

625 • **National marine conservation strategies.** A national marine conservation strategy outlines a country's vision, goals and objectives for protecting marine and coastal ecosystems and biodiversity and securing a clean, healthy, safe, and productive marine environment, including connectivity conservation, and building resilience for climate change. This is an important tool for governments to use to underpin planning, policy-making, and programme development relevant for connectivity. A national marine conservation strategy provides a policy vision and commitment to certain goals which can be used as a basis for supportive legal frameworks and programmes. A national strategy provides an important opportunity to spell out government's commitment to specific principles such as marine biodiversity conservation, marine ecosystem maintenance, sustainable resource use, MPA networks and ecological connectivity, science-based decision making, integration and coordination of regulations across sectors, recognizing connectivity between coastal and marine waters, ecosystem-based management and larger-scale area-based marine management, and use of the precautionary principle when there is scientific uncertainty. The strategy should be developed and implemented with broad participation of other sectors and stakeholders at all stages.

626 • **Ecological criteria.** MPA-related legislation should include explicit ecological criteria for implementing connectivity conservation measures for MPAs and MPA networks. This was the finding of a major study out of the University of Guelph, Ontario, Canada, which analysed Canadian and United States marine conservation and related laws to determine legal adequacy for creating supportive corridors and other connectivity conservation areas. The study considered broad ecological criteria such as scale and size, currents, topography, and water mixing that may define connectivity and biodiversity richness) as well as specific criteria such as migration patterns, recruitment patterns, species of interest, and vulnerable habitats. The study concluded that both Canadian and American legislative coverage of such ecological criteria was insufficient or completely lacking in most jurisdictions even though legal provisions already existed for MPAs for varying reasons, and recommended that ecological criteria should be made explicit in amended or new legislation. (Vásárhelyi and Thomas, 2008).

627 • **Area-based marine planning and management.** In coastal countries, especially where the ocean area is large or highly diverse in natural properties and human use, national (or regional) marine management plans are an important tool for rationalizing uses and dedicating resources to conservation areas important for marine biodiversity and ecosystem services. This requirement should be grounded in legislation. Government agencies responsible for plan preparation should be required to use the best available scientific information that is organized, where feasible and relevant, by biogeographical region. They should use and build upon existing surveys, reports, maps, satellite imagery, GIS information, computer modelling, and other relevant tools when designing, implementing, and monitoring effectiveness of such plans for areas of the ocean being covered. Specific management frameworks such as marine spatial planning, ocean zoning, and integrate coastal zone management may be applied to specific areas as needed and feasible.

628 • **Coastal zone management**. Many countries already recognize the concept of integrated coastal zone management (or integrated coastal management or integrated coastal and ocean management) and some countries have developed governance regimes for this purpose. Many sectors are commonly involved in use of a country's marine environment and marine living and non-living resources. These include fisheries, tourism, shipping, mining, offshore oil and gas exploration

and production, the military, and customs. There are also likely to be new or anticipated uses such as renewable energy production, aquaculture, bio-prospecting, and using different zones for climate change adaptation and mitigation.

- **Coastal conservation legislation.** Building a governance regime for integrated coastal management is a necessary step for effective implementation of an integrated management framework. New legislation may not always be required or feasible in the beginning. Given the time it may take to get new legislation through the political process to enactment, it is important to start with legislation already available. 629

  In many countries, some coastal development control and conservation laws may already exist. Coastal legislation should support natural connectivity in several ways. Normally, such legislation defines inland and offshore boundaries, and includes boundaries that recognize important natural features that may go beyond administrative lines, such as estuaries, bays, tidal streams, mangroves, beaches, and sea grass beds. Coastal legislation normally includes planning and management requirements especially for special areas serving specific objectives such as for fisheries, buffers, and recreation. It may provide authority to zone specific coastal sites for protection, for example, as marine and coastal protected areas, special habitat areas for birds or turtles, or other coastal marine management areas such as tidal streams flowing into the sea. It may require that special uses (for example, hotels, commercial businesses, marinas, industrial operations) must have permits or licenses where conditions may be attached. Some coastal laws also now recognize sea level rise and those coastal areas most vulnerable to climate change that may need special protections and management. All these measures provide opportunities and the responsibility to incorporate connectivity. 630

- **Public property and private use rights.** In contrast to many terrestrial areas important for connectivity conservation (where there may be a mix of private or community property), submerged lands, resources, and waters in coastal and marine ecosystems are generally considered public property. In most countries, the national government has jurisdiction over coastal and marine waters and sea bottom, subject to international law. In some countries, state or provincial governments have jurisdiction over near-shore areas. While there may be governance issues between state entities, generally the issue of private ownership does not arise. This jurisdictional picture should make it simpler in relative terms for governments to take a lead in addressing connectivity needs of MPAs and MPA networks. However, in some countries there may be customary rights over certain elements of these areas, for example, defined coastal waters for artisanal fishing, or seabed areas for harvesting marine life. There may be long-standing traditional marine tenure and resource use rights for fishing and coastal communities that need to be accommodated in marine connectivity arrangements. In addition, as discussed above, there are many sectoral interests overseen by government agencies and sector legislation that still require an extensive participatory process involving technical agencies and the community interests to define and implement connectivity conservation measures in most marine and coastal environments. 631

- **Enforcement**. Marine and coastal environments present special challenges for enforcement of connectivity needs of particular marine species and important marine ecosystems. The two most common legal tools for protecting connectivity are MPA networks and restrictions or prohibitions on use of certain resources. For example, licenses may be required for fishing or other marine activities needing control. Prohibitions on taking of endangered species (sea turtles, whales, sharks) or harming critical ecosystems (coral reefs, deep sea vents) may be enacted with lists of specific species and sites that are totally protected or general protections for types of ecosystems (for 632

example, all coral reefs, deep sea vents). The extensive bodies of water and the special biophysical features of marine environments (subsurface, water column, surface waters, etc.) make serious monitoring, surveillance, and enforcement by government agencies difficult and in most cases prohibitively expansive, as discussed in the *Guidelines for Protected Areas Legislation* (Lausche, 2011, p. 262-263).

633 Among the many techniques for meeting these challenges, three are worth a special note here because of their growing usage. These three techniques could be explicitly recognized in legal provisions relevant for marine connectivity. First, new technologies using remote sensing, satellites, and GPS increasingly are being employed to supplement traditional monitoring and enforcement through reporting logs and patrol boats. These technologies can help identify where vessels may be in relation to specific marine connectivity areas and chemical analyses can link specific pollutants to the source. Second, special efforts may be taken by government to promote compliance through voluntary actions and self-enforcement. Building awareness and understanding among different user groups of the connectivity needs and benefits being protected, particularly in critical sites for habitat or biodiversity, is an important element for promoting compliance. Incentive tools might also be explored. Third, marine authorities may develop partnership agreements with local communities and traditional and commercial user groups, as well as with conservation organisations, for surveillance of different coastal and marine areas, reporting suspicious behaviour, and collaborating with officials on monitoring activities.

634 • **Marine connectivity and climate change.** A central goal of modern legislation for marine conservation is to protect the health of marine ecosystems and biodiversity in order to sustain and, as needed, enhance the functions and services provided to humans and nature. In light of growing scientific consensus that climate change has serious impacts on the marine environment, an important objective to reflect in legislation is to provide connectivity areas for climate change adaptation and, in the case of those coastal areas with high carbon storage functions, for mitigation. In addition, legislation should direct that marine management strategies and plans include attention to the role of marine connectivity in the face of current and anticipated climate change. It is important that MPA legislation contain principles and objectives including to establish interconnected MPA networks to preserve and strengthen connections and transition zones (among other things), and allow for possible shifts in species distribution due to climate change. Legislation also may give special mention to protecting, restoring, and where possible, expanding those coastal ecosystem types important for marine connectivity and carbon sequestration, such as tidal salt marshes, mangroves, seagrass meadows, and kelp forests, that are efficient carbon sinks and, where possible expand those areas

Key messages

635 **Existing legislation**. Most coastal and island nations have some domestic legislation covering aspects of marine conservation, management, and use which have some regulatory controls, standards, and requirements for use of coastal and marine space and resources that make connectivity a necessary consideration for implementation. These laws may include protected areas legislation covering marine areas, site-specific laws for particular marine protected areas, specific marine species protection laws (for example, for sea turtles, whales), and integrated coastal zone management laws.

New and emerging management concepts. Many marine-related laws and legal systems have not been updated with latest scientific understandings and concepts with marine conservation and management to support marine and coastal connectivity conservation. Important elements to consider when strengthening or developing new legislation include requiring ecologically-based MPA networks not just separate sites, providing scientific and ecological criteria for selecting sites for such networks, and requiring an ecosystem-based approach to overall marine spatial planning, management, and conservation, including for connectivity. 636

Key messages

This final section offers some key messages that have been distilled by the authors from the many topics addressed in this concept paper. Because the overall objective of the project has been to analyse issues and present options from the perspective of their direct or indirect relevance for connectivity law, virtually all of the messages offered below are in some manner law-related. For ease of reading and to reflect the lay out of the paper overall, these messages have been clustered according to the major themes of the paper, recognizing that there will be overlap. 637

Connectivity science and management

Emerging science. In recent decades, connectivity conservation has become an increasingly important conservation theme in the field of nature conservation, particularly where areas important to support the integrity and function of formal protected areas and biodiversity conservation are being fragmented and degraded by development and other human impacts. Its scientific foundations come principally from the fields of conservation biology and ecology. It is a dynamic, emerging science supported by a large and growing body of scientific literature covering the natural and social sciences, and applied research. 638

Many scales and levels. Depending on the connectivity need, connectivity conservation may be at different spatial scales, from continent-wide and national levels, to individual sites at local or community levels. Considerations of temporal scale also may be critical since the time over which connectivity conservation needs apply at a particular site or region may be on seasonal, annual, or multi-year cycles – elements essential for migratory connectivity for example. Legal considerations should take into account these several levels and scales. 639

Large-scale connectivity areas. Recent scientific literature places increasing emphasis on the importance of large-scale geographic areas (including regional and continental scale) when determining overall connectivity goals. This is important because such a large-scale approach permits the incorporation of broader ecosystem processes and addresses long-term global changes, such as climate change. It is especially at these larger spatial scales where connectivity considerations and mandates need to be reflected in national conservation strategies, conservation plans, and land use strategies and plans. Appropriate legal frameworks are also necessary to establish and support large-scale connectivity areas. 640

Ecosystem-based approach. Identification of connectivity conservation needs between specific protected areas or as part of a protected area system should be based on conservation planning that is itself guided by an ecosystem-based approach. Because this approach is fundamentally science-based, it takes into account biodiversity conservation needs, current threats, and global change, including climate change. An ecosystem-based approach should be recognized in law. 641

Connectivity planning. Connectivity conservation is a fundamental aspect of effective conservation planning at both the strategic and site levels. Planning for protection of critical ecological and biodiversity linkages for protected areas and protected area systems or networks is essential if specific sites and the associated systems are to have ecological integrity and sustainability over the long-term. Such planning is necessary to combat current and ongoing threats as well as new threats and global change, including climate change. While not legally binding in themselves, many national biodiversity 642

policies provide a strong enabling tool for conservation planning, including connectivity planning, on the ground.

643 **Protected areas and connectivity.** Connectivity conservation areas are not a substitute for protected areas and protected area systems and networks. Their role is to build natural linkages between protected areas and other valuable biodiversity sites where the land or marine areas involved either do not qualify for formal protected areas status or are intended to remain in other economically productive uses such as agriculture or forestry. Assessing legal needs for connectivity conservation should start with an assessment of the existing protected areas legal framework and the additional legal provisions that may be required to meet the connectivity needs of the protected areas and protected areas systems involved. Legal elements for connectivity conservation should complement protected areas legislation and conservation planning.

644 **Active management.** Connectivity conservation objectives cannot be satisfied simply by prohibiting harmful land management. Active management by landholders of land and the natural resources to which they have use rights is a vital component of connectivity conservation over the long-term. Targeted conservation agreements voluntarily negotiated between government agencies or NGOs, on the one hand, and landholders or those with rights over natural resources, on the other, are an essential mechanism for achieving active management. Voluntary conservation agreements are an important mechanism for delivering targeted incentives for active management.

Benefits

645 **Benefits for biodiversity.** Connectivity conservation has the potential, in general, to help advance protected area and associated biodiversity goals. It provides a wide array of biodiversity benefits important to nature and people. Well-designed connectivity conservation areas help restore and maintain biodiversity and protected area systems and networks by providing space and ecosystem resilience for adaptation to current and new threats, as well as global change, including climate change. Such areas assist plant and animal species, populations and communities by providing corridors and ecological networks that maximize their ability to adapt. On a large spatial scale, connectivity areas facilitate the migrations of animals between breeding and wintering areas (whether on daily, seasonal, or annual cycles), even if no protected areas are specifically established for their habitat. Connectivity helps maintain critical ecosystem functions important for providing water and other goods and services to people. On a smaller scale, connectivity conservation provides important biodiversity benefits for local areas. Hedgerows, forest belts around agricultural fields, and patches of natural vegetation interspersed in semi-developed areas are examples of connectivity conservation measures which provide habitat for locally important species (birds, butterflies, amphibians) and local ecosystem services. Where feasible, the law should provide incentives for landholders to undertake such measures.

646 **Benefits for climate change.** While connectivity conservation areas are primarily designated to support protected areas and other biodiversity conservation goals, many landscapes and seascapes may have connectivity value for protecting existing carbon stocks and increasing the natural capacity to store more carbon through restoration. Legal elements supporting connectivity conservation planning and management should recognize and promote this connectivity role whenever possible.

647 **Co-benefits.** Science-based, well-managed connectivity conservation areas can be a tool for biodiversity conservation and ecosystem protection that simultaneously contributes to climate change adaptation and mitigation. Such a strategy can help build the integrity of international emissions reduction mechanisms such as REDD+. REDD+ provides a robust platform for ensuring that projects supported through this mechanism deliver co-benefits for biodiversity and critical ecosystem services.

REDD+ offers new opportunities. REDD+ is an opportune entry point for establishing as well as financing connectivity outside protected areas, with private sector financing fast becoming a major contributor for REDD+ alongside public funds from multilateral, bilateral and domestic sources. REDD+ can serve as a design and management vehicle for ensuring biodiversity and community co-benefits are delivered by properly orienting where protection and reforestation or restoration efforts are positioned. This can maximize connectivity of natural habitats and in the process assist animal, plant and human populations adapt to climate change impacts. In addition, the need for periodic measurement, reporting and verification (MRV) of REDD+ activities presents an opportunity to use connectivity conservation to establish practical criteria and indicators for monitoring and evaluating connectivity in REDD+ activities and programmes already being developed and implemented across the developing world. 648

Governance

Good governance. Good governance principles apply in all public decision-making and fully apply here as well. These principles include providing safeguards to ensure meaningful participation of affected stakeholders at all levels; taking into account of traditional and local knowledge; accountability and transparency in decision making; use of the subsidiary principle (management responsibility with the institutions closest to the resources at stake) where appropriate, and applying the rule of law for justice, equity and benefit sharing. 649

Tenure variations and mixtures. In many jurisdictions, landscape/seascape areas and local sites where connectivity conservation is important will be partly or wholly on non-state owned or non-state controlled lands. Landholders may be private individuals, local communities and indigenous peoples, corporations, NGOs, and other groups. This will especially be the case with large-scale connectivity conservation areas where a mix of tenure arrangements and many owners is likely. Tenure characteristics of specific areas also may change with time as ownership and use rights pass to new owners or next generation users. 650

Shared governance. Governance arrangements for connectivity conservation are still in the early stages of development. Significant challenges are posed where connectivity conservation areas cover a range of land tenures and land uses and involve many stakeholders, which will ordinarily be the case. No single model of governance arrangements will work for all connectivity conservation areas. The different tenures, stakeholders and existing and potential land uses in specific connectivity conservation areas will be important factors in designing the appropriate site-specific governance arrangements. Large scale initiatives, covering a range of landholder and resource use tenures, will depend upon partnerships between civil society and government in some form of shared governance. Arrangements are likely to evolve over time, responding, for example, to changes in the partnerships involved. NGOs and, in many societies, indigenous and local communities, will often assume significant responsibilities. This requires elements in the law which can provide flexibility for change while safeguarding the overall security, clarity, and objectives of the law for implementation. 651

Governance and government. Governments have an important role to play as regulators, catalysts and facilitators, providing funding and putting in place relevant legal and policy settings to directly regulate connectivity and to enable and support community and individual landholder approaches to implement connectivity. This may, for example, include regulating logging or vegetation clearance for agriculture where detrimental to connectivity, paving the way for voluntary land use management agreements to be reached, and providing incentives for landholders to enter into such agreements. 652

Governance and communities. Where the interests of indigenous and local communities are compatible with conservation connectivity objectives, this will have significant implications for 653

governance arrangements. Bottom-up initiatives that empower communities and landholders are more likely to succeed where the communities or landholders have a clear interest at stake that benefits from cooperation with connectivity conservation.

654 **Precautionary decision making.** Precautionary decision making applies when considering connectivity measures and this should be reflected in legal provisions for connectivity conservation. The precautionary principle requires an adaptive approach to management because connectivity is a dynamic process. There may be significant uncertainties about the long-term conservation value of a particular approach to connectivity, especially in light of climate change and future uses of associated landscapes and seascapes.

655 **Duty of care.** In some countries, there is a basic principle whereby landholders have a general duty of care for their land/resources which at least includes management to prevent soil erosion, groundwater pollution, acidification and salinization. Landholders may be required to comply with this duty of care by direct regulation. It is more rare to see this general landholder duty of care being extended to active management of private or community lands or resources specifically for nature conservation. Incentives are a key government tool to persuade and encourage landholders to take additional conservation actions on their lands or with respect to the resources they control in order to promote connectivity conservation. There are many incentive tools, as stressed below, and to be legally secure and clear, available incentives need to be incorporated in legislation.

656 **Voluntary conservation**. While direct regulation through land use planning and development control may help preserve existing connectivity from more fragmentation through development, regulations' role in restoring connectivity through active conservation management will be limited. Active management may require modification of existing land or resource uses, or restoration of degraded areas. Connectivity conservation initiatives requiring active management of private or community lands should rely heavily on voluntary conservation actions and the use of voluntary conservation agreements. Incentives and other non-regulatory measures that promote voluntary action are essential here. To reinforce the use of voluntary conservation actions for connectivity, legal instruments and other supporting mechanisms should explicitly provide that connectivity conservation is among the conservation purposes for which voluntary conservation agreements may be made.

657 **Many incentive tools for voluntary conservation.** An array of incentive tools exist and new ones are being explored to promote voluntary conservation by private and community landholders, landowners, and rightsholders. These include economic instruments that provide positive incentives such as management payments, subsidies, or direct funding. Incentives may be used to encourage landholders to change land use management practices, provide environmental services from the land, undertake general environmental stewardship activities compatible with connectivity conservation, or directly undertake connectivity conservation projects. Non-economic incentives include technical assistance, education, and training. Market-based incentives include new and emerging tools such as conservation or habitat banking, use of transferable development rights and biodiversity offsets, and linking connectivity to emissions trading.

Legal instruments

Generic considerations

International law and connectivity. Virtually all global and regional legal instruments dealing with biodiversity, climate change, and natural resources require states to provide for adequate connectivity conservation or otherwise promote such connectivity. Country initiatives to integrate connectivity conservation into their legal frameworks should be consistent with international law obligations and commitments, as well as relevant transboundary agreements and arrangements. 658

Connectivity and legal support. Legal authority to undertake connectivity conservation in support of protected area systems and other biodiversity conservation goals is essential if such measures are to be effective over the long-term in achieving those goals. Explicit recognition of connectivity conservation and its role in nature conservation has become increasingly important not only to respond to accelerating threats of a long-standing nature, but also to respond to new threats from global change factors such as climate change. 659

Many existing legal tools. In most legal systems, an array of substantive laws and regulatory and incentive tools already exist that could be used to provide legal support for connectivity conservation. Countries should start with these tools and, to the extent such tools permit, take measures for connectivity conservation before such measures are no longer economically or politically feasible. The formal process of amending or enacting new legal instruments to strengthen the legal framework for connectivity conservation normally takes some time and efforts for connectivity conservation should not be delayed for that reason. In many countries, essential mechanisms for facilitating connectivity conservation are already available. When amendments are needed, it may be desirable or necessary to consider a phased approach. 660

Legal approaches will vary. Available legal instruments and tools will vary from country to country. There is no single approach but rather a variety of possibilities. For instance, connectivity conservation legal elements may be incorporated within an umbrella law (for example, for nature, biodiversity, environmental protection, or land use). Provisions may be incorporated in specific laws, where, including protected areas laws and sustainable resource use laws, to the extent that achieving their primary purpose requires taking into account connectivity conservation. Land use and development control laws are also important supportive laws for connectivity. Laws providing economic and non-economic incentives for voluntary conservation and environmental stewardship also should recognize connectivity conservation as a valid use of such incentives. This is particularly important since connectivity conservation actions, in most cases, will need to rely heavily on voluntary conservation. Where necessary and appropriate, a distinct law for connectivity could be enacted; this is a relatively new approach being tried in some countries especially on a site-specific bases, for example, for large-scale corridors. 661

Explicit legal authority. Where feasible, legal instruments should provide explicit authority to take into account connectivity conservation. As laws are amended or expanded in areas relevant for connectivity conservation, provisions should be added to provide explicit authority for connectivity planning and for integrating connectivity as part of relevant existing laws. This applies to protected areas, conservation and sustainable resource use legislation as well as land use, development control, water and other relevant sector laws. Legal mechanisms to provide economic and other incentives for voluntary action and to recognize voluntary conservation agreements should authorise their use for connectivity conservation. 662

663 **Legal integration across sectors**. One of the most problematic areas for connectivity conservation, especially in large-scale areas, has to do with the many uncoordinated and often overlapping or conflicting sectoral policies and laws impacting connectivity conservation in positive or negative ways. It is essential to identify and assess laws and policies in those other sectors and, as needed, integrate and harmonize objectives and implementation to avoid conflict and counter-purposes. Experience to date suggests that a useful institutional technique for cross-sectoral coordination is to authorise a lead agency from existing institutions or to create a new coordinating mechanism with representatives from the key sectors involved. In some cases such arrangements are provided in legislation and have a statutory basis. It also is important to emphasize that normal agency operations carried out as part of government administration provide ongoing opportunities for cross-sectoral cooperation, through such means as regular or period inter-ministerial or technical agency meetings, interagency workshops on special issues, and cross-sectoral staff meetings.

664 **Connectivity through protected areas legislation**. Modern protected areas legislation contains several elements that provide important connectivity mechanisms, from using the ecosystem approach in protected areas design and management, designating buffer zones, and planning protected areas as part of systems or networks, to recognizing the need for adaptive measures for climate change The *Guidelines on Protected Areas Legislation* elaborates several fundamental connectivity elements. Legal elements for connectivity conservation should be incorporated into and complement protected areas legislation. In situations where protected areas laws are outdated, countries should undertake reviews to identify gaps and new elements required to meet modern needs, and any resulting amendments or new legislation should incorporate connectivity. At the same time, taking steps to implement connectivity should not wait for adoption of new or revised legislation but should begin with the many instruments that may already exist to begin to provide legal support.

665 **Advance conservation planning**. An essential component of any connectivity conservation initiative is advance conservation planning of land/sea uses across broad landscapes/seascapes before specific development projects are proposed. This is critical in order to have the opportunity, among other things, to identify the appropriate boundaries and functions of a connectivity conservation area and appropriate management needs in order to advance a holistic approach to maintaining and restoring essential ecological processes, and the integrity of natural ecosystems, biological diversity, and important wildlife habitat. A tool being increasingly recognized to help with such planning is the Strategic Environmental Assessment (SEA). The use of SEA for identifying connectivity conservation needs as part of conservation and development planning should be incorporated in legislation.

666 **Land use planning**. Land use planning which regulates the development of particular areas has an important role to play in setting fundamental ground rules to support connectivity conservation initiatives. In particular, zoning can be used to identify significant areas and to protect them in advance from incompatible use. In addition, the Environmental Impact Statement (EIA) is an important tool to ensure that proposed development activities are in compliance with environmental protections provided in land use plans, including connectivity conservation protections, and the use of EIAs for identifying connectivity conservation needs should be incorporated in land use plans and corresponding legislation.

667 **Land use and conservation planning**. It is important that strategic and site-specific conservation plans include connectivity considerations and that these plans be integrated into the regulatory land use planning process, not only in making the plans but also in their implementation through development decision-making. This integration will help ensure that biodiversity and ecologically significant areas identified in such conservation plans are adequately protected from incompatible development. In jurisdictions where land use plans have a non-legally binding status, the same integration principle

should apply so that development decision-making is responsive to conservation policies, vision, and values important for effective land use planning.

Development control. Development control legislation is crucial when it comes to preserving existing connectivity in intact landscapes, and preventing incompatible development in areas that are being restored to reinstate connectivity in fragmented landscapes. Jurisdictions which regulate development through land use planning systems that cover both urban and rural areas have the greatest potential for delivering comprehensive regulation for connectivity conservation as part of sustainable development. Where development control is not linked to land use planning, regulation of development may be patchy and less effective. 668

Conservation and development control decision making. To support connectivity conservation objectives, legislation needs to make it clear that development approval bodies must take nature conservation and associated connectivity values into account before making decisions, and to give them significant weight. Legislation also should provide that where approval is required and there are connectivity issues, approval should include specific conditions to protect connectivity conservation. 669

Existing uses and development control. Regulation of existing land uses as distinct from regulation of future land uses represents a special challenge for connectivity conservation. Legislation setting out new land use controls and adopting new land use plans in some jurisdictions may exempt existing land uses of private or community landholders from such new requirements altogether by being explicit that the legislation applies only to future land uses. Thus, development control laws that rely on regulations alone to guide and control future land uses may not be sufficient for changing existing land uses for connectivity purposes. The preferable approach here is to negotiate and offer incentives to these landholders to modify current land use practices. Alternatively, where incentives are not sufficient to persuade landholders to act voluntarily and regulation needs to be used, compensation should be provided. This is the practice in those jurisdictions that do allow regulation of existing uses. 670

Economic instruments to support connectivity. Economic instruments provide an additional law and policy tool of growing importance for connectivity conservation. In contrast to direct regulation, economic instruments use incentives to influence behaviour. Also, in contrast to direct regulation, they introduce an element of choice. Economic instruments to promote voluntary conservation are sometimes presented as alternatives to direct regulation, but in practice they are commonly used in combination. 671

Positive incentives for active management. In the context of connectivity conservation, some of the most frequently used economic instruments offer positive incentives to landholders to achieve certain conservation objectives on their lands. While direct regulation has an important role to play in controlling proposed incompatible development, it is much less useful for imposing 'active management' obligations on landholders, such as adopting traditional agricultural or sustainable forestry practices, or restoring wildlife habitat. In these circumstances, positive incentives may be the only tool in many cases for convincing landholders to actively manage their land for connectivity conservation. Such positive incentives include tax reductions or payments by public authorities to change existing management practices. 672

Payments for ecosystem services. A new economic tool receiving increased attention for promoting voluntary connectivity conservation actions is the contractual arrangement whereby public authorities or private stakeholders provide landholders with 'payments for specific ecosystem services' (PES) (for example, watershed protection to sustain water supplies) in exchange for the landholder undertaking compatible land and water management practices to secure those services. As a new tool, PES has 673

promise but needs further development to ensure its effectiveness for achieving the desired ecological objectives and mechanisms to secure continuous funding over the long term.

674 **Conservation banking**. Conservation banking is emerging as a market scheme with potential for connectivity conservation. Conservation banking legislation exists in a few jurisdictions to provide the legal framework whereby landholders may create clearly defined biodiversity credits on their lands through active conservation management that enhances biodiversity values with arrangements that guarantee the long-term security of these credits. One approach for creating a market for biodiversity credits is to encourage developers to purchase them to satisfy biodiversity offsetting requirements.

675 **Biodiversity offsets**. In some jurisdictions, developers are increasingly being required to provide biodiversity offsets to compensate for the damage their proposed development projects will cause to biodiversity, including loss of connectivity. The legislative objective is for biodiversity destroyed on a development site to be replaced by restoration of biodiversity values on another site so that, overall, biodiversity values are at least maintained. This, however, is scientifically controversial because of the difficulty of determining that the biodiversity values being gained are indeed equal to those being lost. Offsetting does ensure that the developer pays in some way for lost biodiversity values. Where legislation on conservation banking is linked to offsetting, it has the potential to combine offsets so as to conserve large, strategically located areas rather than isolated fragments. It therefore has considerable potential as an economic tool for achieving connectivity. In spite of these possibilities, the preferred approach should be to permit development only in very exceptional circumstances in areas which are already significant for biodiversity conservation, including connectivity.

676 **Tradable development rights (TDRs).** TDRs represent another potential economic tool for connectivity conservation. The idea is to use TDRs to create a market to protect areas of high conservation value on private and communal land. Here, however, development credits, not conservation credits are traded. One of the attractions of this tool is that it avoids the need to offset the negative environmental efforts of proposed development on a high-value conservation site because development on that site is prevented and the 'right' to develop is transferred to another site of lesser conservation value. This tool also is at an early stage of experimentation and important issues for connectivity conservation will need to be addressed before it is an effective tool for that purpose. For example, TDR programmes typically have no automatic mechanism for ensuring that the protected site (where development has been prevented) will be actively managed for conservation. Such issues could be addressed in voluntary agreements with the landholder responsible for managing the protected site.

Special marine considerations

677 **Existing legislation**. Connectivity conservation presents special challenges for marine and coastal environments because of their special biophysical features and many, frequently uncoordinated, uses and legal authorities involved. In addition, national legislation is only valid for those parts of the marine environment under national jurisdiction. Nevertheless, because of current threats to marine and coastal environments and new threats, particularly from climate change, there is a growing need for connectivity conservation to be an essential component of marine biodiversity and ecosystem conservation and management. For this purpose, some legislation already exists. Most coastal and island nations already have some domestic legislation specifically covering aspects of conservation, management, and use of marine or coastal resources which can be used to support connectivity conservation. These laws include general legislation for marine protected areas; coastal conservation, management and development control; site-specific laws for particular marine protected areas, and specific marine species protection laws (for example, for sea turtles, whales). While these laws may not

explicitly recognize connectivity, their effective implementation requires that connectivity conservation is a necessary consideration

New and emerging management concepts. Many marine-related laws in national/subnational legal systems have not been updated with latest scientific understandings needed to provide effective support for marine conservation and management, including marine and coastal connectivity conservation. Important elements to consider for connectivity conservation when strengthening or developing new marine and coastal legislation include creating ecologically-based marine and coastal protected area networks not just separate sites, providing scientific and ecological criteria for selecting sites for such networks, requiring an ecosystem-based approach to marine and coastal conservation management, and promoting area-based conservation and management through such tools as marine spatial planning, ocean zoning, and integrated marine and coastal resource management. 678

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