PEOPLE ON THE MOVE

REDUCING THE IMPACT OF HUMAN MIGRATION ON BIODIVERSITY

Authors: Judy Oglethorpe
Jenny Ericson
Richard E. Bilsborrow
Janet Edmond

USAID FROM THE AMERICAN PEOPLE
WWF
CONSERVATION INTERNATIONAL
UNC CAROLINA POPULATION CENTER

PUBLICATION CREDITS

AUTHORS

Judy Oglethorpe, World Wildlife Fund-U.S.

Jenny Ericson, Consultant

Richard E. Bilsborrow, University of North Carolina

Janet Edmond, Conservation International Foundation

PUBLICATION SERVICES

Balmar Printing, Mary Memminger, 202.682.9825
Ellipse Design, Randy Cook, 703.289.9067
www.balmar.com

FUNDING

This publication is made possible by the generous support of the American people through the United States Agency for International Development (USAID). The contents are the responsibility of the authors and do not necessarily reflect the views of USAID or the United States Government.

We gratefully acknowledge support of the Gordon and Betty Moore Foundation.

PHOTO CREDITS

Cover: Refugees returning to Rwanda after the genocide © UNHCR / R. Chalasani
The authors gratefully acknowledge permission to use the photographs in this publication. Individual photographers are acknowledged in the photo credits beside their photographs; we are grateful to USAID and UNHCR for providing us with material from their photo libraries. Special thanks go to Susan Hopper and Anne Kellner (UNHCR), Patricia Adams and Shawn Phillips (USAID), and Jill Hatzai and Roberto Brooks (WWF-US photo library).

Please cite this publication as: Oglethorpe, J., Ericson, J., Bilsborrow, R. E. and Edmond, J. 2007. *People on the Move: Reducing the Impacts of Human Migration on Biodiversity.* Washington, DC: World Wildlife Fund and Conservation International Foundation.

WWF
1250 24th Street, NW
Washington, DC 20037
USA
www.worldwildlife.org
e-mail: **ecoregionsupportinfo@wwfus.org**

CONSERVATION INTERNATIONAL FOUNDATION
2011 Crystal Drive, Suite 500
Arlington, VA 22202
USA
www.conservation.org

Dedication

This publication is dedicated to all those who died in the helicopter crash in Nepal on September 23, 2006. Migration is a major issue in the Eastern Himalayas, and many of those who perished were working toward a bold vision whereby people in the region will live in greater harmony with nature.

TABLE OF CONTENTS

Table of Figures, Tables and Maps iii
Acknowledgments v
Acronyms vi
Executive Summary vii

Chapter 1 - Introduction 1

1.1 Why Should Conservationists Care About Migration? 1
1.2 The Human Face of Migration 1
1.3 Why This Publication? 3
1.4 Who This Publication Is For 3
1.5 What Is Not Included in This Publication 3

Chapter 2 - Patterns of Human Migration Affecting Biodiversity 5

2.1 Global Scale of Migration 5
2.2 Types of Migration 5
2.3 Migration and Natural Population Growth 6
2.4 Regional Population Trends 7
2.5 How Do Different Migration Trends Affect Biodiversity? 7
2.5.1 Rural-to-Rural Migration 7
2.5.2 Urban-to-Rural Migration 7
2.5.3 Rural-to-Urban Migration 9
2.5.4 Urban-to-Urban Migration 9
2.6 Where Do the Impacts Occur? 9
Box 1. U.S. Border Migration and Conservation .. 10

Chapter 3 - What Causes Migration and What Are the Impacts? 11

3.1 Push Factors 11
3.2 Pull Factors 11
3.3 What Is Driving Migration? 15
3.3.1 Land, Resources and Regional Development 15
Box 2. Migration and Infrastructure in the Amazon 16
Box 3. Human Migration and Infrastructure in Asia 17
3.3.2 Markets and Trade 17
Box 4. Migration and the Mining Sector 17
3.3.3 Natural and Man-made Disasters 18
3.3.4 Armed Conflict 18
3.3.5 Family and Social Connections 19
3.4 Impacts on Local Residents 19
Box 5. Integration of Migrants in the Philippines .. 20

Chapter 4 - What Migration Trends Can We Expect in the Future? 21

4.1 Population and Consumption 21
4.2 Globalization and Trade 22
4.3 Climate Change 22
Box 6. Africa's Vulnerability to Climate Change . 23
4.4 Armed Conflict 23
4.5 Emerging Diseases 23

Chapter 5 - Deciding Whether and How to Intervene 25
5.1 Understanding the Situation 25
5.2 Coordination Across Sectors 25
5.3 Working at Multiple Scales 27
5.4 Time Frame for Results 28
Chapter 6 - Interventions to Reduce Migration Impacts on Biodiversity 29
6.1 General Typology of Interventions 29
6.2 Who Should Use These Interventions? 29
6.3 Interventions in the Case Studies 32
6.4 Policy Interventions 32
6.4.1 Economic Development Policies 32
6.4.2 Sectoral Policy 33
Box 7. Land Policy in Mozambique 33
6.4.3 Subsidies, Trade Tariffs and Tax Incentives 35
6.4.4 Conventions and Agreements 36
6.4.5 Indigenous Peoples Policy 36
Box 8. Protecting the Rights of Indigenous Peoples in the Peruvian Amazon 36
6.5 Field-Level Interventions in Areas of Origin 37
6.5.1 Improving Access to Land and Resources 37
6.5.2 Improving Resource Use 37
6.5.3 Improving Livelihoods 38
6.5.4 Making Arrangements for Retrenched Workers 39
6.5.5 Improving Social Services 39
6.5.6 Providing Access to Reproductive Health and Family Planning 40
6.5.7 Communicating the Conditions of the Destination Area 40
6.5.8 Encouraging Migrants to Return to Area of Origin 40
6.5.9 Promoting Climate Change Adaptation 40
6.6 Field-Level Interventions in Areas of Destination 41
6.6.1 Promoting Sound Zoning 41
6.6.2 Carefully Planning and Restricting Road Development 41
6.6.3 Creating Protected Areas in Sensitive Areas 42
Box 9. Mining Agreements with Communities in CAR 43
6.6.4 Ensuring Law Enforcement for Land and Resource Use 43
6.6.5 Encouraging Voluntary Resettlement 44
6.6.6 Strengthening Land and Resource Tenure 45
6.6.7 Limiting Plot Size and Intensifying Agriculture 45
6.6.8 Developing Alternative Livelihood Opportunities 45
6.6.9 Setting Quotas and Promoting Lower-Impact Extraction Methods 46
6.6.10 Improving Access to Family Planning 47
6.6.11 Providing Social Services 47
6.7 Interventions for Armed Conflict and Natural Disasters 47
6.7.1 Supporting Local Community Livelihoods 47
6.7.2 Reducing Impacts of Refugees and Internally Displaced Persons 48
6.7.3 Promoting Sound Environmental Practices in Refugee and IDP Camps 49
6.7.4 Encouraging Sound Resettlement After Conflict or Disaster 50
6.7.5 Integrating Demobilized Soldiers into Society 50
6.7.6 Participating in Postwar Policy Development and Reconstruction 50
Chapter 7 - The Importance of Monitoring 53
Box 10. Population Monitoring System Example 54
Chapter 8 - The Way Forward: Recommendations 55
Chapter 9 - References 57
Annex 1 - Case Studies 65

Annex 2 - Planning Interventions and Selected Resources 89

A.2.1 Resources to Help Plan Interventions 92

A.2.2 Resources to Help on Migration Technical Issues 92

A.2.3 Useful Web Sites 92

Figures

Figure 1. Trends in percentage of people living in rural areas, 1950–2030 7

Figure 2. Trends in rural population in select countries, 1950–2030 (in thousands) 8

Figure 3. Basic diagram showing push and pull factors causing migration 12

Figure 4. General conceptual model depicting push/pull factors and biodiversity impacts related to migration 26

Figure 5. Conceptual framework for migration in the Spiny Forest, Madagascar 90

Figure 6. Results chain for road improvement in area of origin, Spiny Forest 91

Figure 7. Results chain for strengthening forest tenure and control by resident groups in area of destination, Spiny Forest 91

Figure 8. Results chain for provision of family planning services/reproductive health in area of origin, Spiny Forest 91

Tables

Table 1. Human migration and conservation case study areas 2

Table 2. Types of migrants 6

Table 3. Push and pull factors from the case studies 12

Table 4. Types of possible migration intervention by scale and sector 30

Table 5. Results of species inventory, Song Thanh Nature Reserve, Vietnam 74

Maps

Maps 1-3. Location of case study sites ..... inside front cover

Map 4. Pattern of migration and deforestation in the Amazon ..... inside back cover

Map 5. Location of Juruena National Park in the southern Brazilian Amazon ..... inside back cover

ACKNOWLEDGMENTS

The authors wish to thank all those who offered their time, valuable information and assistance in compiling this review. The idea for the publication arose from a joint Africa Biodiversity Collaborative Group and Community Conservation Coalition meeting on migration and conservation in 2003 in Washington, DC, organized by Nancy Gelman and Carol Boender. We acknowledge the valuable participation of all the case study contributors. For the Africa and Madagascar case studies we are grateful to: Linde Ostro, Terese Hart, Richard Tshombe, Paul Scholte, Davison Gumbo, Newton Moyo, Celestine Lwatula, Allard Blom, Mark Freudenberger, Richard Ruggiero, Mark Fenn, Oliver Pierson, Jennifer Talbot and Adam Tomasek; Asian case studies: James Hardcastle, Barney Long, Valerie Hickey, Dekila Chungyalpa, Anil Manandhar, Sarah Milne, Jim Peters, Jake Brunner, Wayne McCallum, Bunra Seng and Fulai Sheng; Latin America case studies: Keith Alger, Helena Maltez, Bob Buschbacher, Pilar Barrera, Jerry Touval, Jason Bremner, Lauren Spurrier, Jim Nations, Cheryl Margoluis, David Carr and Liza Grandia.

Heather D'Agnes, Fred Boltz, Jason Bremner, Mark Freudenberger, Larry Gorenflo, Mike Mascia, Alex de Sherbinin, Jenny Springer and Susan Stone kindly peer-reviewed the draft and in some cases provided additional information. We thank Karen Baragona, Allard Blom, Michael Case, Jason Clay, Dekila Chungyalpa, Jonathan Cook, Owen Cylke, Jane Dwasi, Mark Fenn, Philipp Goeltenboth, Tom Grasso, Davison Gumbo, Lara Hansen, Barney Long, Anil Manandhar, Jennifer Montoya, Mariana Panuncio, Matt Perl, Voahanginirina Rasoarinoro, Nanie Ratsifandrihamanana, Etika Rupeni, Wendy Smith, Kelly Soudre, Lauren Spurrier, Meg Symington, Anita van Breda and Rick Vieira for providing information and comments on parts of the document. Some of the approaches in this publication are drawn from WWF staff who attended migration sessions at the workshop on Global Ecoregion Conservation in Antalya, Turkey, in 2005. Caroline Stem, Tenley Dalstrom and Ewan Oglethorpe assisted with the conceptual models. Tom Outlaw provided strong encouragement in the early stages. Tenley Dalstrom provided valuable support on research, photos and proofs. The following individuals helped shape the research and bring it to publication: Cheryl Margoluis, Drew Crandall, Terhi Majanen and James-Christopher Miller. Sheila Donoghue and James Oglethorpe provided valuable inputs on design. Everyone who contributed enriched the publication, for which we are extremely grateful. However, the opinions expressed, and any errors made, are ours alone.

We received generous support for this publication from the Gordon and Betty Moore Foundation and from the U.S. Agency for International Development (USAID) Office of Natural Resources Management and the Office of Population and Reproductive Health.

We are grateful to the Instituto Nacional de Pesquisas Espaciais (INPE), Brazil for permission to reproduce Map 4, and to WWF Brazil and Instituto Centro de Vida (ICV) for permission to reproduce Map 5. Mark Denil from CI's Center for Applied Biodiversity Science produced the Case Study maps; Jessica Forrest in WWF produced the map in section 6.6.

Finally, Judy would like to thank her family for their wonderful support and tolerance during all the weekends she spent working on the publication.

ACRONYMS

ADB	Asian Development Bank
BBC	British Broadcasting Corporation
BRIC	Brazil, Russia, India and China
CACID	Committee for the Support of Conservation and Sustainable Development Initiatives (Cameroon)
CAR	Central African Republic
CCPF	Central Cardamom Protected Forest
CI	Conservation International
CIFOR	Center for International Forestry Research
DHS	Demographic and Health Survey
DOF	Department of Forests
DRC	Democratic Republic of Congo
EU	European Union
FA	Forestry Administration (Cambodia)
FAO	Food and Agriculture Organization of the United Nations
FARC	Revolutionary Armed Forces of Colombia
GDP	Gross Domestic Product
GMS	Greater Mekong Subregion
HIV/AIDS	Human Immunodeficiency Virus/Acquired Immunodeficiency Syndrome
ICDP	Integrated Conservation and Development Project
IDP	Internally Displaced Person
ILO	International Labour Organization
INCRA	Instituto Nacional de Colonização e Reforma Agrária
IRD	Integrated Rural Development
IUCN	World Conservation Union
MOSAIC	Management of Strategic Areas for Integrated Conservation (Vietnam)
MST	Movimento dos Trabalhadores Rurais Sem Terra (Brazil)
NGO	Nongovernmental Organization
NP	National Park
NPCA	National Parks Conservation Association
NTFP	Non-Timber Forest Products
SARS	Severe Acute Respiratory Syndrome
SEA	Strategic Environmental Assessment
STNR	Sang Thanh Nature Reserve
TAL	Terai Arc Landscape
TNC	The Nature Conservancy
UN	United Nations
UNEP	United Nations Environment Program
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFPA	United Nations Population Fund
UNHCR	United Nations High Commissioner for Refugees
USAID	United States Agency for International Development
USFS	United States Forest Service
USFWS	United States Fish and Wildlife Service
WCS	Wildlife Conservation Society
WTO	World Trade Organization
WWF	World Wildlife Fund/World Wide Fund for Nature

EXECUTIVE SUMMARY

Human migration poses huge challenges to conserving the Earth's rich biodiversity, yet conservationists are often unsure about what steps, if any, they can take to reduce its negative impacts. Conservation International (CI) and World Wildlife Fund-US (WWF) undertook this review to explore the scope of negative impacts and possible interventions.

Migration has impacted biodiversity and local residents' natural resource management systems for centuries and will continue to do so, as people move within and between countries for economic opportunity, better living conditions and greater security. Impacts include species and genetic loss, habitat loss and fragmentation, loss of ecological connectivity, and disruption of ecological and evolutionary processes. Biodiversity impacts from migration occur through unsustainable use of natural resources, destruction of habitats, pollution, climate change, and spread of invasive species and disease. Local residents may lose control over land and resources, livelihoods may be seriously impacted and people may be displaced by migrants. This trend is likely to continue and accelerate in the face of the huge anthropogenic forces at play in the world today: population growth, increasing consumption of natural resources, environmental degradation, globalization of trade, climate change, conflict and emerging diseases.

Migration that adversely affects biodiversity is usually rural-to-rural, including movement to remote areas, forest frontiers and coastal areas with greater land and resource availability. It can, however, also be urban-to-rural, rural-to-urban or urban-to-urban. It occurs mainly within countries but can also cross international borders. Many migrants move for better economic and living conditions, including land and natural resources, but others move because of conflict or natural disasters; some are forced to move because of poverty or insecurity. Environmental impacts usually occur in destination areas but sometimes also in areas of origin or along migration routes. Migration can happen rapidly, normally much faster than population growth due to fertility. If migrants have large families, there can be important second-generation impacts. Migration can be long term or temporary.

Each migration is driven by a complex and unique set of drivers, sometimes referred to as push and pull factors, which operate in the areas of origin and destination, respectively. Root causes of push and pull factors may arise far from these sites (for example, global market forces). Push factors include scarcity of or inadequate access to land and resources, lack of employment opportunities, poverty, population pressure, environmental degradation, natural disasters, civil unrest and conflict. Pull factors include access to land and resources, employment opportunities, access to markets, access to facilities and amenities, safety, security, family reunification and networks.

There is no blueprint for reducing the environmental impacts of migration, because each situation is different. In order to decide whether and how to intervene and reduce the impacts, it is very important to first understand these complex circumstances and their likely social impacts on migrants and residents. A good way to analyze and understand these forces is to develop a conceptual model that maps out the direct threats and their drivers. Since it is one phenomenon in a very complex set of economic, political, social, cultural and environmental circumstances, migra-

tion should not be considered in isolation. And it is crucial to screen proposed interventions to identify likely social impacts and take them into account as part of the decision-making process. Many migrants move not from choice but from desperation, because of poverty or insecurity. Migrants often have no power to voice their viewpoints. We seek solutions that work for people as well as the environment: for both local residents and, where possible, the migrants themselves.

Although there is no blueprint, there are many possible ways to reduce the environmental impacts of migration. These include influencing migration patterns, and reducing migration's adverse impacts when it does occur, by working at the policy level and intervening at field level in the area of origin or destination. There are specific interventions for conflict and disaster situations. In practice a combination of interventions may be necessary, operating at different scales from local to national, and sometimes at regional and even global scales. Different interventions may operate in very different time frames; policy interventions, for example, take much longer to bear results. This document reviews a wide range of possible interventions, drawing wherever possible on existing experience.

Responding to migration is a relatively new concept for the conservation sector. In some cases people have tried to address the immediate migration threats such as resource extraction or land occupation by taking action in areas of destination or at policy level, but have not tackled the indirect drivers and root causes that push people from their areas of origin. Indeed, some of the root causes seem too large and challenging for the conservation sector alone. We often need to collaborate and develop partnerships with other sectors in order to intervene. And it is important to acknowledge that in some cases there may be no feasible course of action.

It is too early to draw many conclusions about the most effective types of interventions, because there are relatively few documented examples of interventions in the conservation context that have been monitored rigorously. It is clear that careful monitoring of both migration patterns and the interventions is needed. This type of information can provide a basis for rigorous learning in the future about the effectiveness of interventions, enabling analysis of successes as well as failures.

The conservation sector still has much to learn about migration and the types and effectiveness of interventions. The following are proposed next steps:

- Increase awareness of impacts of migration on biodiversity through improved documentation and dissemination of additional in-depth case studies.
- Pilot emerging approaches and strategies for migration, with monitoring of the effectiveness of interventions.
- Conduct further review of likely biodiversity impacts of global migration trends.
- Develop diagnostic tools to help conservation practitioners to analyze and develop appropriate interventions.
- Conduct a global review of migration threats to biodiversity by region, to map current and future threats.
- Periodically review progress on migration.
- Increase funding for migration, which tends to be overlooked by donors because it falls across many different disciplines.

We hope that this exploratory publication will broaden discussion on human migration and the environment, and lead to the development of practical tools and new approaches for conservation practitioners in the future. We look forward to collaborating with many different projects and partners to develop better understanding and guidance on ways to deal with migration and its impact on biodiversity.

INTRODUCTION

1.1 Why Should Conservationists Care About Migration?

Human migration poses important challenges to conserving the Earth's rich biodiversity and critical ecosystems. There is increasing pressure on biodiversity-rich areas from people seeking better living conditions, greater opportunities and improved security (Cincotta & Engelman 2000a, 2000b). The land and natural resources of these areas often attract people seeking to escape from poverty, environmental degradation and civil unrest. In contrast to the gradual and predictable changes in population caused by high human fertility, migration flows can cause rapid and unexpected increases in population size and density, can be difficult to control and can have sudden impacts on biodiversity (Bilsborrow 2002, Borrini-Reyerabend 1997, de Sherbinin & Freudenberger 1998).

The main direct negative impacts of migration on biodiversity are as follows:

CREDIT: © WWF-Canon / Mark Edwards

Migrants from overcrowded Java turn patches of rainforest into subsistence farms in Sumatra, Indonesia.

- Species and genetic diversity loss from an area
- Habitat loss and fragmentation
- Loss of ecological connectivity and disruption of ecological and evolutionary processes

These impacts occur through the following direct threats:

- Unsustainable use of natural resources
- Habitat destruction
- Pollution
- Climate change
- Spread of invasive species and disease

Conservation practitioners and policymakers often recognize the direct threats posed by migration and have some understanding of the underlying drivers. However, they may not know whether and how to intervene to reduce migration and its impacts. Migration is extremely complex and may need to be addressed at multiple levels. There is a tendency to address only the direct threat: for example, increasing guard patrols in protected areas to reduce illegal entry and harvesting of resources. But on its own, this move can exacerbate conflict, and seldom provides a long-term solution. In many cases there are possible interventions that can work closer to the root causes of migration, finding solutions for both people and biodiversity.

1.2 The Human Face of Migration

Although most migrations are related to socioeconomic factors, a growing number of migrants are forced to move because they are fleeing persecution, civil unrest, natural

disasters or desperate poverty (Wood 1994). While this publication focuses on ways for the conservation sector to reduce negative impacts of migration on biodiversity, we would like to stress the importance of seeking solutions that work for people as well as the environment. This includes both local residents in destination areas whose livelihoods may be threatened, and migrants themselves.

It is easy to blame migrants for problems that may develop as a result of migration. Local residents may find their social institutions disrupted and livelihoods affected, losing control over land and resources. They may even be displaced to more marginal or remote areas (Curran & Agardy 2002, Irvine 2000, Valdivia 2005). Migrants also often lack locally specific knowledge about ecological and social systems (Browder 1995, Curran & Agardy 2002), and their technology may be inappropriate for the ecology of their new place of residence (Begossi 1998, Williams 2002). Often the environmental impacts of migration are due simply to an increase in the number of resource users in an area.

The degree to which migrants are blamed for excessive resource extraction often depends on public perception and the degree to which migrants have been assimilated into the local context (Cassels et al. 2005). Migrant populations are usually poorer than the population in destination areas and thus tend to have less of a voice and ability to defend themselves (Piore 1979). As a result, migrants may be blamed for environmental damage that results from a complex set of factors, of which migration is only a part. Due to this complexity, proposed interventions should be screened to determine potential social impacts. This complexity is also why partnerships with other sectors, such as development and humanitarian assistance, are important when working on migration.

Table 1. Human migration and conservation case study areas

Region	Country	Region or Protected Area(s)
Africa and Madagascar	Democratic Republic of Congo	Okapi Faunal Reserve
	Cameroon	Waza-Logone area
	Zambia	Copperbelt region, including state forest, and Chembe Bird Sanctuary
	Central African Republic	Northwestern Congolian lowland forests, including Dzanga-Sangha Dense Forest Special Reserve
	Madagascar	Spiny Forest region, including Tsimanampetsotsa National Park (NP), Andohahela NP, Cap Ste. Marie Special Reserve, Beza Mahafaly Special Reserve, Berenty Private Reserve
Asia	Vietnam	Greater Annamites Ecoregion, including the Song Thanh Nature Reserve
	Nepal	Nepal part of Terai Arc, including Chitwan NP, Parsa Wildlife Reserve, Bardia NP, Suklaphant Wildlife Reserve
	Cambodia	Southwestern region, including Central Cardamom Protected Forest
Latin America	Brazil	Atlantic Forest, including Una Biological Reserve
	Colombia	National parks in general, but specifically Sierra Nevada de Santa Marta, La Macarena and Catatumbo-Bari
	Ecuador	Galapagos Islands
	Mexico	Lacandón Forest, including Montes Azules Biosphere Reserve, Chan K'in Wildlife Refuge, Bonampak Natural Monument, Lacantun Biosphere Reserve, Yaxchilan Natural Monument, Cojolita Communal Mountain Reserve of the Lacandón Community, Naja Flora and Fauna Protected Area, Metzabok Flora and Fauna Protected Area
	Guatemala	Maya Biosphere Reserve

1.3 Why This Publication?

Faced with migration challenges in many of the world's critical biodiversity areas, Conservation International (CI) and World Wildlife Fund (WWF) collaborated in this exploratory review to identify ways to reduce the negative impacts of human migration on conservation and resident local communities. This publication is based on a general overview of migration-environment dynamics prepared by Richard Bilsborrow and a series of 13 case studies prepared by Jenny Ericson. A framework of interventions was developed and other examples were added when the final document was compiled, drawing from experiences around the world from WWF, CI and other organizations. The case studies are based on literature and interviews with policy-level and field-based practitioners. They illustrate migration impacts and interventions from Africa and Madagascar, Asia, and Latin America. Table 1 lists the case studies, which are further described in Annex 1. Unfortunately, our budget did not allow us to test pilot interventions as part of this phase.

WWF and CI plan to use this exploratory work as a foundation for a better understanding of the linkages between human migration and conservation. We hope to follow this effort with further work on developing and monitoring pilot interventions. In addition, we hope to develop a tool kit for conservation organizations that helps to identify appropriate interventions for addressing the impacts of migration on biodiversity. Migration results from a complex set of economic, political and sociocultural factors, which must be considered comprehensively to determine which (if any) interventions are appropriate and feasible.

1.4 Who This Publication Is For

This publication is designed primarily for conservation and natural resource management practitioners, decision-makers, and project and program managers. It caters to field staff, headquarters staff and policymakers. Donors and environmental impact assessment teams may find it useful for predicting direct and indirect consequences of projects, reducing adverse effects and monitoring. It may also be of value to development and humanitarian assistance organizations working with natural resource-dependent communities and displaced persons.

1.5 What Is Not Included in This Publication

This publication considers only migration impacts that adversely affect conservation and discusses possible interventions to reduce those impacts. Migration flows that benefit the environment are not covered, although we recognize their importance. This document does not cover population movements such as human trafficking, smuggling or tourism.

CREDIT: © CI / Haroldo Castro

Young Malagasy worker in rice paddies, Madagascar

CHAPTER 2

PATTERNS OF HUMAN MIGRATION AFFECTING BIODIVERSITY

2.1 Global Scale of Migration

The absolute number of international migrants is higher than ever before, estimated in 2005 at 191 million persons living outside their country of birth, up from 180 million in 2000 (United Nations [UN] 2006). It is estimated that approximately 3 million migrate across borders each year (Global Commission on International Migration 2006). However, internal migration may be about 100 times as large each year (Bilsborrow *et al.* 1997, Castles & Miller 1998, UN 2002). There are large numbers of international refugees and internally displaced persons (IDPs), respectively 9.2 million and 25 million in 2004 (United Nations High Commissioner for Refugees [UNHCR] 2005). IDPs are especially numerous in Sub-Saharan Africa and the Middle East, reflecting continuing poverty, political problems, regional conflicts, natural disasters and threats of international terrorism. It is more difficult to estimate the number of "environmental refugees"—people forced to move because of drought, degraded land, rising sea levels, impoverished resources, deforestation and environmental conflict.

2.2 Types of Migration

Migration is a complex demographic event that has both temporal and spatial dimensions (Bilsborrow *et al.* 1997, 1984). Migration may be long term (such as migration to the forest frontier and to cities) or temporary (such as

CREDIT: © UNHCR / R. Chalasani

Mass return of refugees to Rwanda after the genocide, following a decision by the Tanzanian Government to close the refugee camps by the end of 1996; at the time of the photograph taken in the Ngara area, Tanzania, about 100,000 people were on the move forming a 43 km long column towards the border.

Table 2. Types of migrants

Name	Definition
Temporal Migrant Types	
Long-term migrants	Change their residence for long periods of time, usually defined as 12 months or more
Temporary migrants	Move for short periods of time and do not change their primary residence
Other Descriptive Categories of Migrants	
Economic migrants	Engage in remunerated activities in a state in which they are not nationals, including ■ *Temporary labor migrants* (also known as guest workers or overseas contract workers): People who move for a limited period of time to take up employment and send money home ■ *Highly skilled and business migrants:* People with qualifications for employment who move with the internal labor markets of large international corporations and organizations, or who seek employment through international labor markets for scarce skills ■ *Irregular migrants:* People in search of employment who enter a country without legal documents or permits
Family reunification migrants	Join family members who have already entered an immigration country as part of any migration category
Internally displaced persons	Forced or obliged to flee or leave their homes or places of habitual residence, in particular as a result of or in order to avoid the effects of armed conflict, situations of generalized violence, violations of human rights or natural or man-made disasters, and who have not crossed an internationally recognized state border
Refugees and asylum seekers	Wish to escape an armed conflict, violence, the violation of their rights or a man-made disaster, generally to an area outside of their original nationality; includes people forced to move due to external factors such as development projects or natural disasters
Return migrants	Return to their country of origin after a period away in another country
Seasonal migrants	Move regularly with the seasons in search of labor, education or production opportunities
Transient migrants	Individuals without a fixed place of usual residence. including ■ *Nomads:* Move from one site to another according to well-established geographic patterns ■ *Wanderers:* Move without a well-established pattern or activity

Sources: Bilsborrow *et al.* (1997, 1984), Bremner (2006), British Broadcasting Corporation (BBC) (2006), Migration Policy Institute (2006), United Nations Educational, Scientific and Cultural Organization (UNESCO) (2006)

fishermen and loggers who return home after pursuing seasonal labor opportunities). Table 2 defines the different types of migrants and migration considered in this publication. We were unable to find a single recognized typology, so the definitions in Table 2 are drawn from various sources. The categories, therefore, are not mutually exclusive.

2.3 Migration and Natural Population Growth

Population growth can occur in two ways: through migration and naturally due to fertility. Migration often occurs much more rapidly and less predictably than natural population growth. A high-fertility population experiencing natural annual population growth of 3 percent will grow by 35 percent in 10 years. But through migration, growth in an area can happen much more quickly. For example, during the 1994 genocide in Rwanda, around 1 million refugees settled in the Goma area of the Democratic Republic of Congo (DRC), with devastating impacts on local forests (Hart & Mwinyihali 2001, UNHCR 2000).

At site level, migration is often seen as the major cause of rapid population growth, contributing to resource degradation and biodiversity loss in areas of destination. However, after the migrants have settled, natural population growth becomes increasingly important. Migrant populations with higher fertility levels will have a greater impact on the area. It is therefore crucial to consider this second-generation effect as well as the first-generation effects of the initial migration. However, the fertility of migrants is usually lower than that of rural counterparts who do not migrate, and the fertility of migrants to urban areas tends to approach that of the resident urban population after the move (Goldstein & Goldstein 1981).

2.4 Regional Population Trends

Migration and natural growth over the past century have caused profound changes in the world's population size and distribution, primarily through a major rural-to-urban shift. As a result, at the turn of the new millennium, only a quarter of the population of the developed world and Latin America lived in rural areas. Yet in Asia and Africa—home to three-quarters of the world's population—nearly two-thirds of the population still lives in rural areas, although there are rural-urban migration trends (UN 2004). Indeed, over the next 30 years, the urban population of the world is expected to grow by the same amount (2 billion) as the world total, so there will be no net overall rural population growth. During this time, the percentage of people living in rural areas in developing regions is expected to fall from an overall level of 60 percent in the year 2000 to 43 percent by 2030 (UN 2005). The percentage of rural people and its change over time varies widely by region in the developing world, as shown in Figure 1.

Despite these projections, rates of rural population growth will continue to be positive in many parts of the developing world due to natural growth, and will be substantial (around 1 percent or more per year) in much of Africa and parts of Asia. For example, annual rates of rural population growth in the next three decades are expected to exceed 2 percent per year in Yemen and Uganda, followed by more than 1.5 percent in Somalia, Burkina Faso, DRC, Afghanistan, Liberia, Ethiopia and Burundi. Countries experiencing such large increases in their rural populations will confront growing pressures on resources and may well experience further environmental degradation in rural areas. Figure 2 shows predicted increases in rural populations for selected countries.

2.5 How Do Different Migration Trends Affect Biodiversity?

2.5.1 Rural-to-Rural Migration

Rural-to-rural migrations have the greatest impact on biodiversity, as areas of high biodiversity tend to be in rural, isolated areas. In spite of its importance, rural-rural migration is largely ignored in the literature and in the policy arena, where the dominant focus is on rural-urban migration, city growth and problems associated with urbanization. In a study of 14 countries using 1980s data, rural-rural migration was larger than rural-urban migration in 11 of 14 countries, including the largest three studied: India, Pakistan and Brazil (Bilsborrow 2002). Rural-rural migration occurs increasingly to areas on the agricultural frontier, to lands covered by forests or to marginal areas with low rainfall or steep topography. In some cases people are also moving from inland to coastal areas for better economic opportunities or moving along the coast as marine resources become depleted. In addition, people displaced by civil unrest sometimes seek remote areas far from conflict. Refugee camps are often located near international borders in remote, undeveloped areas away from main population centers.

2.5.2 Urban-to-Rural Migration

Urban-to-rural migration can also damage biodiversity. It often occurs in developing countries during economic downturns, when employment falls in towns and people return to seek a living in rural areas where they may have originated. The current HIV/AIDS epidemic in Africa is resulting in an urban-rural movement, as people affected by the disease can no longer work and must return to rural

Figure 1. Trends in percentage of people living in rural areas, 1950–2030
Source: United Nations (2005)

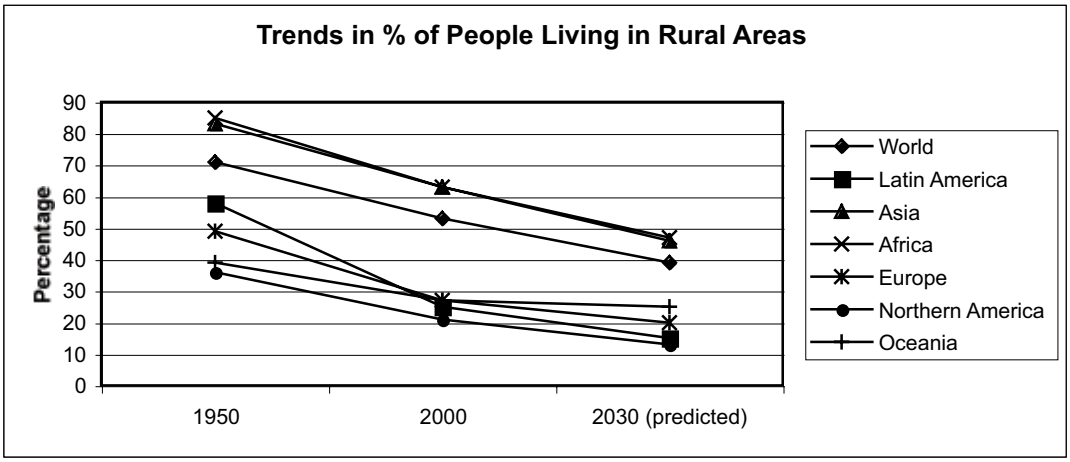
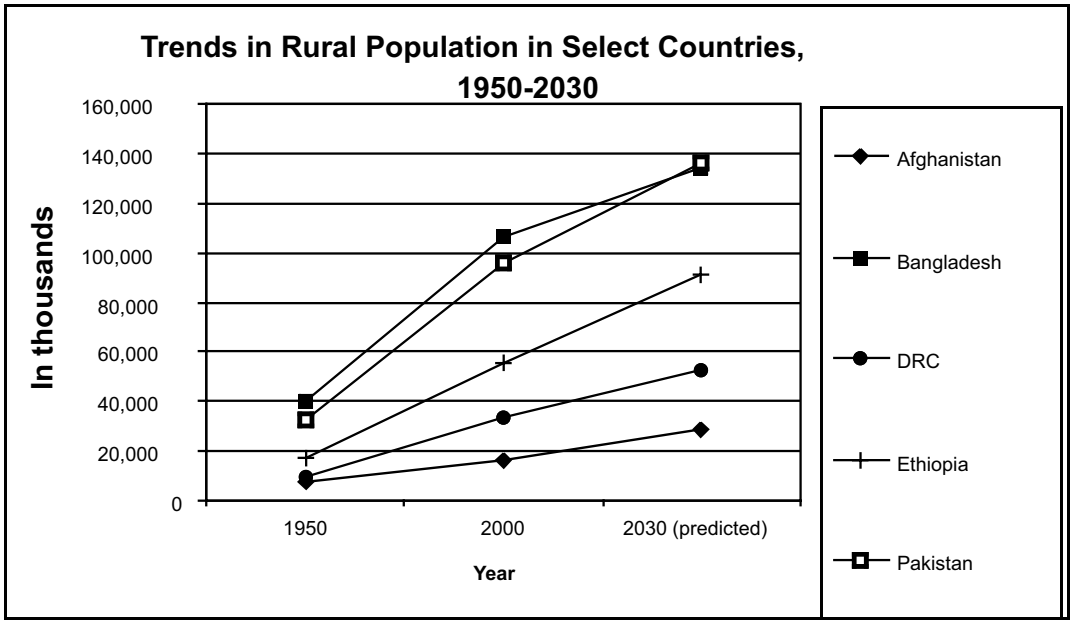


Figure 2. Trends in rural population in select countries, 1950–2030 (in thousands)
Source: United Nations (2004)



areas for care. This places additional pressures on natural resources (Gelman *et al.* 2006). In developed countries where people have increased longevity, retirees sometimes move from towns to rural settings. In the Southeast Rivers and Streams Ecoregion in the United States (which stretches from southern Virginia west to Tennessee and south to Alabama), the increased water demand related to the development of retirement housing as well as industrial

CREDIT: © WWF-Canon / Tantyo Bangun

Urban and industrial development in Balikpapan, Kalimantan, Indonesia

expansion is having large impacts on freshwater biodiversity (WWF Conservation Strategies Unit 2001).

2.5.3 Rural-to-Urban Migration

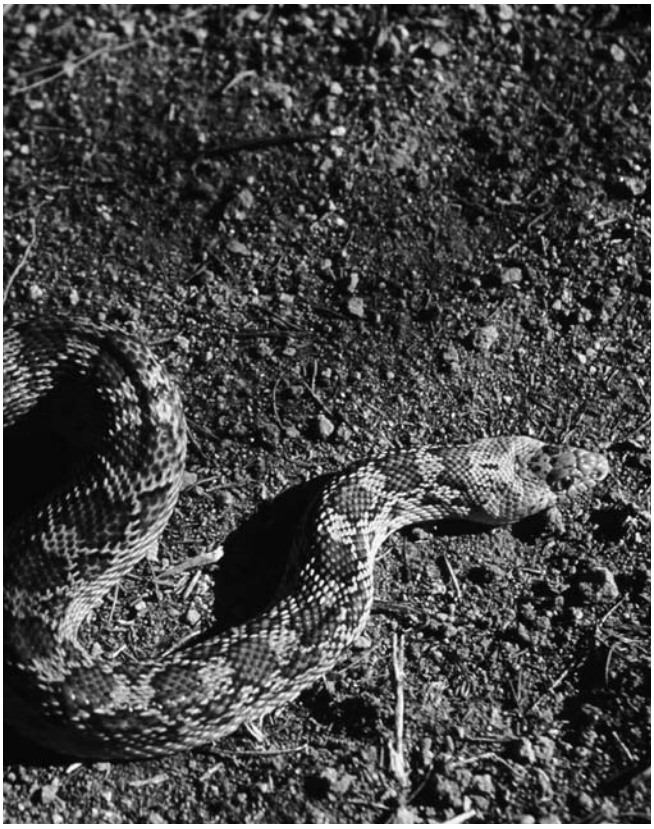
Rural-urban migration typically results in conversion of new land for settlement, increased demand for water, and increased fuelwood consumption if alternative energy sources are not available. Many urban centers in the developing world are surrounded by degraded vegetation, which has been cut for firewood and charcoal. This degradation also occurs along major transport routes. Freshwater sources are increasingly tapped to supply cities and the agricultural schemes that feed their growing populations, affecting freshwater biodiversity (United Nations Environment Program [UNEP] 2001.)

2.5.4 Urban-to-Urban Migration

Urban-urban migration tends to have fewer impacts on biodiversity than the other types, but it can have serious localized impacts. For example, in developed countries such as the United States, urban sprawl can cause severe local impacts as people move out of city centers to expanding haloes of lower-density suburban housing, which use more land per capita (Ewing *et al.* 2005).

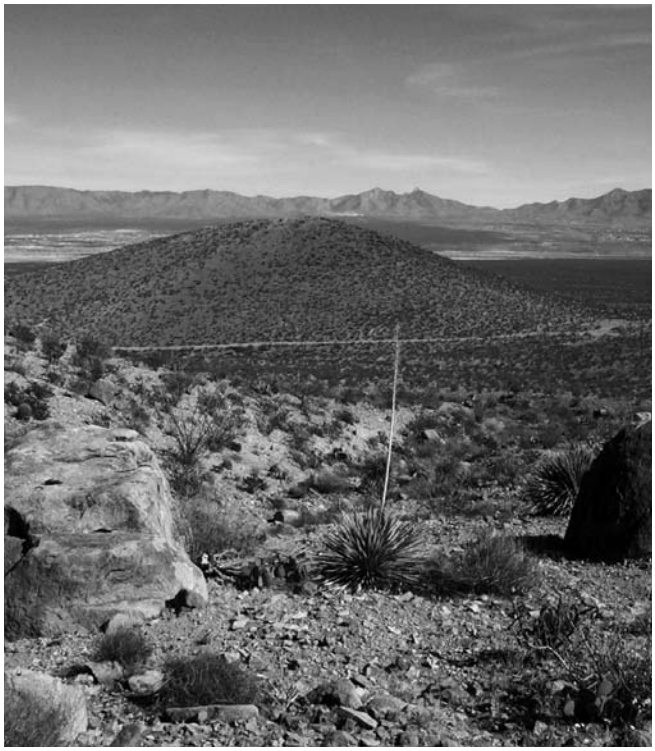
2.6 Where Do the Impacts Occur?

Much of the damage to biodiversity occurs in destination areas where migrants relocate. However, areas of origin can also be adversely affected. For example, when the traditional managers of land and natural resources leave an area, indigenous knowledge of sound management practices may be lost. There may be changes in social relations and governance of resources (Curran & Agardy 2002). There may also be serious impacts along the route of the migration. For example, refugees may have to use natural resources for food, fuel and shelter as they move to safer areas. Illegal immigrants entering the United States from Mexico cause environmental damage to fragile desert ecosystems (see Box 1).



CREDIT: © WWF-Canon / Edward Parker

Pine Snake in the Chihuahuan Desert, Mexico



CREDIT: Justin Van Zee

The Jornada del Muerto (Journey of Death) area of the Chihuahua Desert about 40 miles north of the United States/Mexico border: migrants from Latin America face very harsh conditions when they risk crossing the desert on foot to reach the United States.

Box 1. U.S. Border Migration and Conservation

A large number of illegal immigrants attempt to enter the United States from Mexico every year to seek employment and better living conditions. Success in sealing the border in urban areas in the 1990s shifted the illegal crossings to remote areas including the Chihuahuan and Sonoran Deserts, much to the detriment of immigrants, habitat and wildlife. Since 1995, an estimated 3,600 people have died while trying to cross the border illegally, 415 of them in 2005 alone (Segee & Neeley 2006).

The border runs for 800 miles through the Chihuahuan Desert, where the fragile environment is damaged by a web of illegal vehicle roads and foot trails. Plants are trampled and killed, local populations of animals are displaced, fragile desert soils erode, invasive weed species that have been inadvertently brought in by cars or clothing take hold in newly disturbed soils, fire patterns are disrupted and game animals are poached. Garbage dumps with plastic water jugs, old food cans and wrappers, clothes and pharmaceutical waste (illegal crossers often take drugs to help maintain their stamina) are hazardous to the general public, wildlife and the environment. Rare natural springs are contaminated by bathing, drinking and the dumping of human waste, which puts endangered fish species further at risk. In the Sonoran Desert in Arizona, there are threats to the endangered jaguar and Sonoran pronghorn.

In response to the illegal immigration, the U.S. Border Patrol has set up large outposts on wildlife refuges and public lands. These outposts are disruptive to wildlife and create new mini-towns. The Border Patrol has no restrictions on its all-terrain vehicles, which means that they can drive on sensitive areas such as those set aside to protect riparian areas, mountains, springs and deserts. The Border Patrol also constructs roads and barriers, which can impede wildlife movements. Currently there are few efforts to reduce these environmental impacts, due in part to poor communication between the Border Patrol and environmental agencies.

(Segee & Neeley 2006, Montoya, pers. comm. 2006)

WHAT CAUSES MIGRATION AND WHAT ARE THE IMPACTS?

In order to develop responses to migration, it is important to understand the underlying drivers that are causing it and the mechanisms through which they impact biodiversity—now and in the future. The drivers are often referred to as "push" factors in the place of origin and "pull" factors in the place of destination (Lee 1966; see Figure 3).

Factors that influence people's desire to migrate are both economic, such as employment opportunities, and non-economic, such as security (Skeldon 1990). The ability to migrate is affected by the distances to potential destinations (which affect cost), communications and transportation connections, education levels (which affect access to information) and national policies (Massey *et al.* 1993). Once a migration has occurred, people left behind may migrate to join those who went earlier (Massey 1990). Some individuals, however, may be less inclined to migrate due to psychological emotional attachments to home, family, friends and community (Lee 1966). Individuals who choose not to migrate may pursue various options in an attempt to stay: for example, improving livelihoods by seeking additional land nearby, intensifying agricultural production on existing land, seeking non-farm work, or engaging in temporary or seasonal migration before deciding to move for the longer term (Bilsborrow 1987, Ellis 2000).

3.1 Push Factors

In many cases, push factors are based in economics, though they may also be environmental, sociocultural, political or simply demographic, and may be influenced by the presence or absence of effective policies. They are often complex and inter-related.

Major push factors in areas of origin that can result in migration causing environmental damage include the following:

- Scarcity of or inadequate access to land and resources
- Lack of employment opportunities
- Poverty
- High population pressure
- Environmental degradation, including loss of soil productivity
- Natural disasters
- Civil unrest and conflict
- Rites of passage when young people leave home to make their way in the world

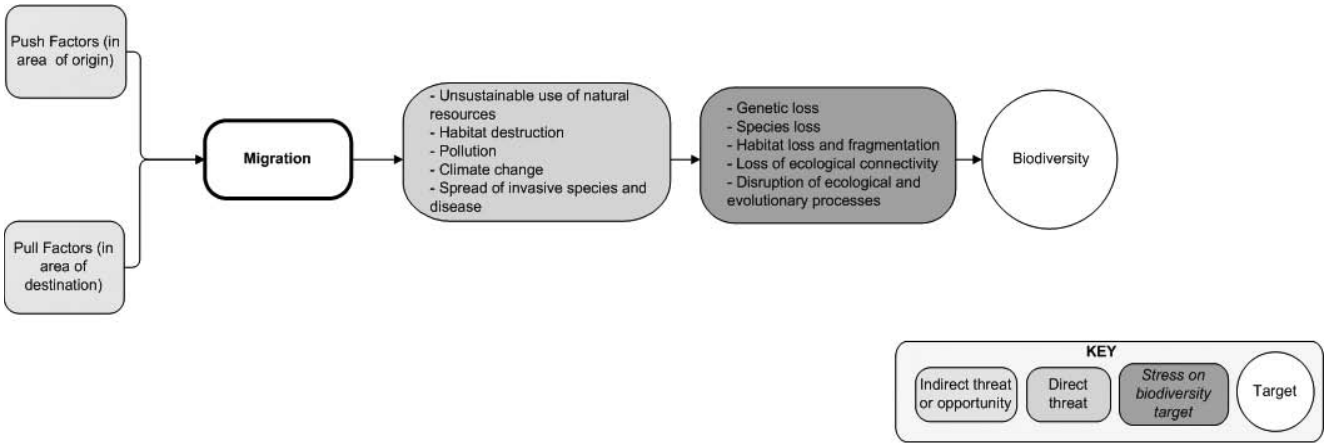
In most of the case studies in Annex 1, economic and livelihood issues linked to insufficient land and rural poverty are involved in pushing migrants out of areas of origin (Table 3).

3.2 Pull Factors

While push factors stimulate people to leave areas of origin, pull factors define where migrants go, seeking to satisfy their needs. Pull factors that may directly or indirectly result in biodiversity impacts include the following:

- Access to land and natural resources (renewable and nonrenewable)
- Employment opportunities
- Access to markets
- Access to facilities and amenities, such as social services and transport
- Safety and security
- Family reunification and networks

Figure 3. Basic diagram showing push and pull factors causing migration



In the case studies, open access to agricultural land and abundant resources (especially forest resources and minerals) were common pull factors, as were employment opportunities, road access and markets for enterprises. Family connections, remoteness of destination areas for those escaping conflict, and policy failure were other pull factors in more than one case study. The push and pull factors in the case studies often occurred over different time frames and were not necessarily all concurrent (Table 3).

Table 3. Push and pull factors from the case studies

Case Study Site and Country	Push Factors	Pull Factors
Okapi Faunal Reserve (DRC)	■ Armed civil rebellions ■ Disarming of reserve guards by invading militants	■ Gold and coltan mining driven by international capital ■ Temporary increase in world price of coltan between 2000 and 2001 ■ Abundant bushmeat; elephant populations illegally exploited for ivory ■ Well-established mining camps attracting settlers who clear land to cultivate gardens to feed the miners
Waza-Logone (Cameroon)	■ Increase in livestock pressure outside the area, causing livestock intrusion during dry season and increasing the number of pastoral camps inside the park ■ Depressions outside the park drying up several weeks earlier than those inside, causing both fishing and grazing activities to move inside the park	■ Integrated conservation and development projects (ICDPs), including reflooding to improve fishing and pastoral conditions, sustainable income-generation activities and ecodevelopment projects ■ Open access to land ■ Absence of land titling

(I) denotes migration is internal to the region
(RU) denotes rural-to-urban migration

Table 3. *(continued)* Push and pull factors from the case studies

Case Study Site and Country	Push Factors	Pull Factors
Copperbelt (Zambia) (I)	■ Lack of employment opportunities in other provinces ■ Social unrest in neighboring countries ■ Decline in price of copper on world market, resulting in closure of mines and causing people to move into rural areas	■ Availability of land for agriculture and forest resources (e.g., for charcoal production) ■ Good network of roads ■ High local market value of agricultural and forest products ■ Foreign markets for products
Dzanga-Sangha (Central African Republic [CAR])	■ Rural and urban poverty, particularly affecting young, educated people who have difficulty finding paid employment ■ Climatic and ecological changes, primarily in the Sahel regions of Senegal, Mauritania, Mali and other countries to the north and west of CAR ■ Sociocultural pressures, such as marriage-related migration where young women follow husbands who work in the diamond mines or workers' complexes	■ Diamond mining and timber economies driven by international capital ■ Employment in resource extraction as well as mining, supporting infrastructure of merchants and services ■ Network of primary and secondary roads ■ Open access to land enabling extraction of natural resources without penalty
Spiny Forest (Madagascar) (I, RU)	■ Culture and tradition ■ Natural and climatic factors (i.e., drought, locusts, cyclones; population growth) contributing to land scarcity ■ Remoteness causing lack of access to markets and social services, sometimes due to deteriorating road infrastructure	■ Demand for labor in settlement areas ■ Existing family or social connections ■ Sharecropping or cash cropping opportunities, access to new technologies, open access land system ■ Good access to roads and urban centers ■ Local and international markets for agricultural, forest and small-scale mining products ■ Opportunity to diversify sources for obtaining revenue ■ Lack of social norms among existing population to discourage new settlers
Greater Annamites (Vietnam)	■ State policy encouraging relocation of isolated, indigenous mountain villages to larger village communities in lowland areas ■ Lack of employment opportunities in other parts of the country	■ Gold mining ■ Accessibility due to construction of Ho Chi Minh Highway linking Hanoi with Ho Chi Minh City ■ Policy contradictions between provincial and national development and zoning plans ■ Unclear land tenure ■ Erosion of traditional lifestyles
Terai Arc (Nepal)	■ Shortage of land ■ Lack of employment opportunities in area of origin ■ Population growth	■ Clearing of public forest land under previous resettlement policies ■ Lack of protection for government forests, signaling available land ■ Good soils and farming opportunities ■ Improved infrastructure development ■ Open access land system

(I) denotes migration is internal to the region
(RU) denotes rural-to-urban migration

Table 3. *(continued)* Push and pull factors from the case studies

Case Study Site and Country	Push Factors	Pull Factors
Central Cardamoms (Cambodia)	■ Population growth, land scarcity in lowlands, loss of forest cover and associated products in rice belt provinces ■ Government-sponsored resettlement to rural areas ■ Families returning to the region to claim prewar land ownership rights	■ Availability of land in highland areas ■ Access to free natural resources ■ Employment in illegal logging and concessions ■ Accessibility due to newly constructed road linking Phnom Penh with Bangkok and Ho Chi Minh City
Atlantic Forest (Brazil)	■ Urban violence, especially against women ■ Unhealthy urban environment ■ Drop in world cocoa prices ■ Lack of economic opportunities ■ Pressure for land reform ■ Lack of land	■ Political land reform movements ■ National law and public policy ■ Judicial practice
Colombia National Parks	■ Displacement of rural communities caused by fumigation of drug-related crops and indirect fumigation of food crops ■ Lack of economic alternatives ■ Pressure from militant groups	■ Remoteness of destinations ■ Demand generated by international drug markets
Galapagos Islands (Ecuador)	■ Increasing urban and rural poverty on the mainland since the 1980s ■ Lack of urban economic opportunities ■ Degraded coastal fisheries on mainland	■ Economic opportunities ■ Family and social connections ■ Lack of enforcement of restrictions on in-migration and of regulations on fishing and tourism ■ Government subsidies, reducing the cost of living and promoting economic activities
Lacandón Forest (Mexico)	■ Displacement of local populations and civil unrest caused by poverty and marginalization of the indigenous peoples of Chiapas ■ Lack of land due to high population densities in other parts of the country ■ Ineffective land reform programs ■ Confusing land-registry laws	■ Social unrest enabling land to be snatched from its owners/users with limited fear of reprisal from the authorities ■ Relative tranquility and remoteness of forest lands ■ Lack of sufficient capacity and park infrastructure to enforce park regulations
Maya Biosphere (Guatemala)	■ Skewed land distribution resulting in landlessness ■ Widespread rural poverty ■ Population growth ■ Environmental degradation ■ Political and social conflicts ■ Lack of employment opportunities	■ Availability of land for agriculture and cattle ■ Avoidance of civil unrest and violence ■ Remoteness of region ■ Accessibility of roads developed for timber and chicle extraction ■ Presence of relatives and friends

(I) denotes migration is internal to the region
(RU) denotes rural-to-urban migration

3.3 What Is Driving Migration?

The following sections outline some of the main drivers and adverse impacts of migration on biodiversity around the world, drawing on the case studies and other examples.

3.3.1 Land, Resources and Regional Development

Land and agriculture: In some countries, notably throughout Latin America and the Philippines, inequitable land distribution and ineffective land reform programs are strong push factors, being closely linked to high rural poverty and income inequality (Pichón 1992). In many countries, the establishment of large commercial land holdings by small numbers of people has displaced local peoples to marginal lands that cannot withstand intensified subsistence livelihood activities, resulting in environmental degradation. Natural population growth, decreasing the amount of resources available to each individual, also acts as a driver to find new land in many places. For example, in northeast Brazil, increased population density along with drought conditions led to a decrease in resource availability. This created a push factor that drove people to migrate to the frontier areas of the Amazon, where the strong pull factor was available land, as well as to cities such as São Paolo, where the pull factor was employment (Wood & Porro 2002).

People often migrate to frontier zones in search of agricultural land or employment in farming or resource extraction. Migrants tend to view frontier areas as open access land systems where land and resources are free for the taking (Mogba & Freudenberger 1997, Pichón 1992, Sawyer & Rigotti 2001). These areas often become de facto open access owing to the lack of clear land tenure policy, poor regulatory mechanisms and/or corruption among enforcement officials. Because frontier areas also tend to have high biodiversity value, agricultural clearing can result in widespread habitat destruction, loss of ecological connectivity and sometimes species extinction (Geist & Lambin 2002).

Biodiversity-rich areas and indigenous peoples' reserves often do not have sufficient on-the-ground protection—law enforcement mechanisms or capacity—to keep people from entering and exploiting resources. In the Montes Azules Biosphere Reserve at the heart of the Lacandón Forest in Mexico, for example, it was estimated in 2002 that about 700 people inhabited 27 unofficial human settlements, but there were only 10 to 15 park rangers on active duty in the reserve. Lack of sufficient park infrastructure and inability to enforce regulations enabled infiltration and exploitation by settlers, which affects not only the Montes Azules, but also the lands and forests of the Naha Flora and Fauna Protected Area and the Lacantun Biosphere Reserve (CI Mexico Program 2002).

Subsidies, trade tariffs and tax incentives have greatly affected migration patterns in several countries by facilitating the development of frontier areas and environmentally damaging land uses, and promoting production of specific crops and commodities that have environmental impacts. Subsidies such as low-cost electricity, food, housing and transportation as well as agriculture/livestock subsidies can distort the costs of production and living in remote areas, often leading to higher in-migration than desired. Examples of such subsidies include the transmigration program in Indonesia, and Ecuador's fuel and transport subsidies in the Galapagos.

The European Union (EU), U.S. and Japanese agricultural subsidies are all very large and affect international trade,

CREDIT: © WWF-Canon / Mauri Rautkari

Intact forest in Kerinci Seblat National Park, Sumatra, Indonesia

CREDIT: © WWF-Canon / Mark Edwards

Migrants resettled from Java clear rainforest for subsistence agriculture in Sumatra near Bukit Tigapuluh.

Box 2. Migration and Infrastructure in the Amazon

In Brazil, government subsidies and construction of roads in the 1960s resulted in a westward expansion of people to tap the vast interior wealth of the Amazon. This provided a release valve for peasants who had insufficient land and lived in densely populated areas, especially the northeast. Several government-sponsored programs initially provided free land and food for six months in Rondonia and elsewhere to attract migrants (Hecht & Cockburn 1990, Henriques 1983). However, many of the original settlers faced severe problems due to poor soils and declining yields, long distances to markets, difficulties in land titling and lack of credit. Many sold or abandoned their holdings and migrated either further into the rain forest to clear new plots or to the boomtowns of the region.

Ranchers, benefiting from the generous tax subsidies, often bought out small farmers or forcibly removed them (Hecht 1985, Hecht & Cockburn 1990, Schmink & Wood 1993). Large cattle ranches contributed to continuing deforestation in the 1990s (Wood *et al.* 1996). Since 2000 there has been a vast expansion of agribusiness for export (mainly soybeans) in the southern Amazon area of Mato Grosso, and the government plans to double the number of paved roads in the Amazon through the Avança Brasil program.

The successive waves of migration in the Amazon have caused forest destruction on a huge scale (Map 4 on inside back cover), and the destructive frontier is still advancing (Food and Agriculture Organization of the United Nations [FAO] 2001). This is resulting in vast biodiversity loss. It is also expected to change the climate in the Amazon Basin through reduced rainfall and evaporation and increased surface temperature. (Various climate models demonstrating this are cited in Avissar & Werth 2005.) These impacts will be felt beyond the Amazon itself, both regionally and globally. Between 25 and 50 percent of rain falling in southeast Brazil originates in the Amazon, and São Paulo in particular is likely to suffer if the Amazon's climate changes due to deforestation (Clement & Higuchi 2006).

harming exports of many developing countries. They have complex impacts on migration and biodiversity beyond their borders, both positive and negative, by influencing markets and hence agriculture patterns in other parts of the world. Preferential trade agreements can also have big and unforeseen impacts: for example, a European Union scheme to stimulate commodity production and exports from overseas territories including Réunion contributed to the migration and deforestation cycle in Madagascar's Spiny Forest through increased maize cultivation for export to Réunion (Minten 2006).

Extractive resources: Extractive resources are a pull factor in many places, particularly in frontier areas. In Africa, the Dzanga-Sangha Special Dense Reserve is threatened by extensive logging in concessions in buffer zones around the reserve and widespread artisanal diamond mining in the northern buffer zone (Mogba *et al.* 1996). In parts of eastern DRC, an inrush of miners occurred in the late 1990s due to a surge in the world price of coltan, a mineral used in the manufacture of computer chips (Hart & Hart 2003). In Asia, the opportunity to mine gold has drawn migrants into the ecologically rich and sensitive areas of Vietnam's Greater Annamites Ecoregion. Mining has several environmental impacts such as water pollution and habitat destruction. In the Guianas and the Amazon, migrant gold miners use mercury to extract gold; mercury poisons water bodies, affecting people and freshwater biodiversity. Miners and loggers in many forest frontier areas also hunt for bushmeat or pay local hunters to hunt for them, which can result in severe reduction in wildlife populations.

CREDIT: © Laura Lartigue / USAID

Diamond miners in Kono, Sierra Leone

Resettlement schemes: Government resettlement schemes in some of the Asian case studies have historically played or are currently playing important roles in the redistribution of people in the landscape. In Cambodia, former military personnel and civilians displaced by the war were given permission to relocate to several areas, including the Cardamom Mountains, which are rich in natural resources. Many of these individuals have since been allowed to sell their land to wealthy land developers (PAD Partnership 2003). In Nepal, lack of employment opportunities and land shortages in the heavily populated hills north of the Terai Arc cause people to descend to the lowland forests (which became habitable following malaria eradication) for agriculture and forest resources. Government resettlement policies in the Terai region are no longer in effect, but local Nepali politicians continue to use them for personal gain (Chungyalpa, pers. comm. 2006). Human settlement in the Terai has resulted in habitat

Box 3. Human Migration and Infrastructure in Asia

In Cambodia, the recently completed, soon-to-be-paved Route 48 skirts the Central Cardamom Protected Forest to the south, facilitating the movement of people into the region. This road will provide a crucial link for transport from Bangkok, Thailand to Phnom Penh, Cambodia and Ho Chi Minh City and Hanoi in Vietnam (Milne, pers. comm. 2005). The organization WildAid has dedicated itself to protecting the forested areas on either side of the road from incursion as the road runs through the central and southern portions of the Cardamom Mountains landscape. Through a somewhat controversial program, WildAid offers relocation packages to migrants in the region to resettle them in a village created especially for them.

This road is part of the ambitious Greater Mekong Subregion (GMS) Economic Cooperation Program, which promotes investment in priority infrastructure sectors of transport, energy, telecommunications and tourism in order to promote economic growth and development and reduce poverty in the subregion. Three economic corridors are building on key transport infrastructure investments to optimize trade opportunities; the initiative has considerable support from the Asian Development Bank (ADB). The economic corridors coincide with areas of high biodiversity and give cause for concern about environmental impacts (Holmberg & Lundgren 2006), which could include wide-scale immigration for employment, mining and agriculture.

fragmentation and loss, disruption of ecological corridors and severe impacts on wildlife species such as tiger, rhino and elephant from hunting and loss of habitat range.

Roads: Development of road networks, particularly in frontier regions, often opens up areas previously inaccessible to migrants. With settlement comes increased land clearing, resource extraction, pollution and hunting. In addition, new roads can bring new large-scale commercial resource extraction, such as mining and timber harvesting. Roads can also disrupt environmental processes such as animal migration and plant dispersal. Large-scale road construction is currently underway in many of the world's last remaining frontier areas, such as the Amazon, Mekong and Congo basins.

CREDIT: © WWF-Canon / Alain Compost

Logging for the paper industry and forest clearing for palm oil plantation development result in new settlements in Sumatra, Indonesia.

Aesthetic surroundings: A pleasant natural setting or climate may also attract migrants, who may degrade or destroy the very qualities they are seeking. This problem includes retirees moving to attractive areas and people moving to establish tourism ventures.

3.3.2 Markets and Trade

Trade can have very large effects on migration. The root causes of trade-related push and pull factors can originate locally, nationally, regionally and globally and often occur far from the area of migrant origin. For example, increased global production of cocoa due to overplanting during a market peak in 1976–77 resulted in large surpluses in the early 1990s and a drop in world prices (Clay 2004). Low

Box 4. Migration and the Mining Sector

A market that was once a pull factor can quickly become a push factor as commodity prices decline or a resource becomes exhausted. Migrants face the choice of moving on in search of new opportunities or staying to develop new livelihoods. Miners in the Zambian Copperbelt region confronted this choice when the declining price of copper on the world market resulted in the closure of mines over the past few decades. Many of those formerly employed in the mining industry and its associated services remained in the region, moving into rural areas around the towns to practice slash-and-burn agriculture, charcoal production and livestock rearing, threatening the ecologically sensitive Miombo woodland (van de Veen 2005). At the same time, European, South African and Asian markets encouraged the exploitation and sale of forest products such as timber, honey and mushrooms in the area, and the unsustainable harvesting practices further contributed to biodiversity loss in the area.

Ironically, this situation is swinging back. The fortunes of the Zambian Copperbelt are changing yet again as copper prices have firmed. Old and new copper mines are now operational, triggering a new wave of migrants into the area. The extent to which the former miners can be taken back into formal employment will determine how much these threats to the Miombo woodland are alleviated.

CREDIT: © UNHCR / C. Shirley

Somali refugees in Kenya displaced yet again after the Tana River floods their camp

prices and high labor costs, combined with disease of cocoa trees, created widespread unemployment on Brazilian cocoa farms. Faced with a lack of alternative economic opportunities and lack of land in areas of origin, many unemployed cocoa workers migrated to forested portions of the Atlantic Forest, especially in the state of Bahia (Cullen *et al.* 2005).

Impacts of market forces on conservation can be complex. Gains and losses in biodiversity can result as production starts up, changes over time (for example, switching from one agricultural crop to another, or introducing new mining technologies) or is abandoned. Migration in response to these drivers is only one of many possible sources of impacts. Conservation organizations need to be aware of global trends as well as local ones.

3.3.3 Natural and Man-made Disasters

Both natural and man-made environmental disasters serve as push factors. Natural disasters include earthquakes, tsunamis, volcanic eruptions, floods, droughts and hurricanes/cyclones. Environmental disasters linked to human activities include flooding resulting from deforestation of watersheds, gradual degradation of the environment due to overuse of resources, soil impoverishment from improper land use practices and human-induced climate change. In the case of the Madagascar Spiny Forest, natural and climatic factors such as long-term drought, locust invasions and cyclones cause people to migrate in search of food, especially when prolonged famine strikes (WWF Madagascar Program undated). In the Dzanga-Sangha Special Dense Reserve of the CAR, migrants come from as far away as the Sahel regions of Senegal, Mauritania and Mali, where drought contributes to their decision to migrate (Mogba & Freudenberger 1997). In the Waza-Logone area of Cameroon, 40 percent of the local population left after construction of a dam that caused changes in the hydrological regime and a dramatic decline in fishing (Scholte 2003).

CREDIT: © CI / Daniel Juhn

Aftermath of 2004 tsunami in Banda Aceh, Indonesia

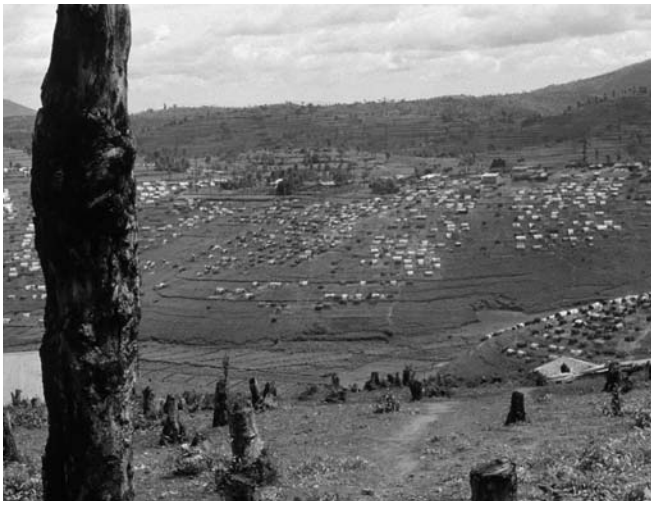
3.3.4 Armed Conflict

Armed conflict can result in large-scale and often sudden movements of people, who migrate when their livelihoods and well-being are threatened. When people are forced to move, they may hide in small groups in remote areas, integrate into existing communities or be accommodated in separate camps, depending on local conditions and the scale of the migration. Protected areas are often targets for people fleeing from civil unrest, because they tend to be located in remote areas with intact vegetation where people can hide. In addition, people may also take advantage of the breakdown of law and order and move into protected areas to harvest resources. In the DRC, several protected areas including the Okapi Faunal Reserve were affected by

displaced people fleeing conflict in the region. In the mid-1990s, armed rebel factions mounted an insurgency which led to fighting with government troops. In 1996 the Rwandan army disarmed Okapi Faunal Reserve guards and forbade them to patrol, so law enforcement was weak and unable to control increasing encroachment of cultivators. An inrush of coltan miners followed in 2000, responding to the brief world price increase in coltan. Cultivation and mining resulted in habitat destruction.

In cases of large-scale migration, refugee and IDP camps may be necessary. Host countries often site them in remote, undeveloped and marginal areas that have valuable but vulnerable biodiversity, where potential environmental impacts are great. If refugees and IDPs do not have adequate food, water and fuelwood, they may cultivate crops, hunt and collect from surrounding areas. This can result in habitat destruction and species loss from the area.

Environmental damage from conflict-induced migration is not limited to areas of destination; areas of origin can also be affected. Refugees and IDPs often return to rural areas to face the huge challenge of restoring their homes, livelihoods, and social and economic structures. In the first year or so before agriculture is re-established, when employment opportunities are scarce and when returnees need building materials to repair or rebuild homes, refugees and IDPs are often particularly dependent on natural resources for food, shelter and cash. Yet at such times traditional community and government natural resource management structures and controls are often weak, and resources may be used in unsustainable ways that can threaten communities' long-term livelihoods.



CREDIT: © UNHCR / A. Hollman

Deforestation around Kibeho camp for internally displaced people, Rwanda 1994

3.3.5 Family and Social Connections

The existence of family and social connections in the destination area can attract migrants, who tend to go where they have family members or community-level connections (Massey *et al.* 1993, Palloni *et al.* 2001). Of course, migrants also favor locations where people from their original communities have found employment and returned to tell the tale (WWF Madagascar Program undated). Perceptions of the destination area are very important in determining whether people will migrate, and previous migrants often exaggerate the benefits of the new area even if conditions are hard, for fear of losing face. Such perceptions can attract migration to an area even if it does not have adequate conditions, causing greater environmental damage.

3.4 Impacts on Local Residents

The arrival of migrants in an area can impact the livelihoods and the resource base on which local residents depend. Migrants often bring new knowledge and technologies to an area and introduce them to existing residents, who may alter their own traditional production systems (Williams 2002). In some cases these changes may be beneficial, resulting in improved agricultural or land use practices. But in other cases they may have a very destructive impact, such as from the introduction of exotic and domesticated plants or animals that can become invasive. In addition, migrants may use the land and natural resources in a less sustainable way than the local people and may undermine the resource base, threatening the livelihoods of incomers and locals alike. In some cases, the arrival of migrants can displace indigenous peoples, forcing them to move to more remote or marginal areas and deepening poverty levels.

The arrival of migrants can also greatly change the social institutions that govern an area. Incoming migrants usually result in a diversification in social structure and can weaken the social bonds of reciprocity and trust often required for land and resource management (Curran & Agardy 2002). To avoid conflict in the Spiny Forest, migrants employ a strategy of gradual integration, beginning with sharecropping for local patriarchs, followed by the establishment of relationships within the community and ending with direct access to land or resources. Some indigenous groups try to keep migrants as sharecroppers with no possibility of access to land or resources. This often results in conflict and the forced move of migrant communities to another settlement area (WWF Madagascar Program undated).

CREDIT: © CI / Haroldo Castro

Group of Malagasy workers going to market

Migrants may also bring in human and livestock diseases that affect biodiversity directly or indirectly. There are many historical records of indigenous peoples being greatly affected by diseases such as measles and tuberculosis that were brought in by colonizers (Diamond 1999). More recently, HIV has been transmitted by migrants, and is a particular problem when migrants move between areas of high and low HIV prevalence rates (Quinn 1994). For example, in Mozambique migration has been largely responsible for the introduction of HIV: In the center of the country it is thought to have been brought back by refugees who fled to Zimbabwe and Malawi during the war in the 1980s, and by soldiers of the Zimbabwe army who were guarding transport corridors in Mozambique. In the south, there is fairly strong evidence that Mozambican gold miners returning from the mines in South Africa played an important role in bringing HIV to southern Mozambique 10 to 15 years ago (Beckman & Rai 2005). When rural households lose salary earners and agricultural labor to AIDS, they often turn increasingly to natural resources as a livelihood safety net—more fishing, hunting, firewood collection and charcoal production have all been reported. If this resource use is unsustainable, future livelihoods can be severely threatened (Gelman *et al.* 2006).

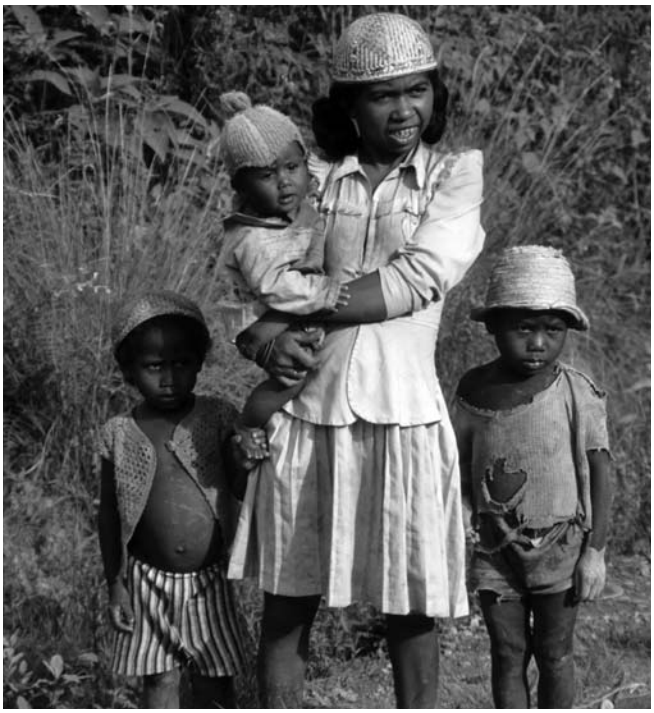
Box 5. Integration of Migrants in the Philippines

In the Philippines, many migrants have moved from the overfished Visayas region to Palawan Province, which is widely considered to be the country's last frontier of pristine and unspoiled natural resources. Migrants who settled on Cuyo Island fish and also harvest the highly lucrative live leopard coralgrouper, a key species in the international trade in live reef fish for food with large markets in Hong Kong and China. The fish live within coral at great depths, so the migrant fishermen introduced cyanide, which also kills coral and non-target species. In recent years there has been escalating conflict between Cuyunons, the long-term residents, and the migrant fishermen. Cuyo was originally colonized by the Spanish in 1622, and Cuyunons consider themselves descendants of settlers, pioneers and cultural and historic ambassadors to the Philippines. They value their island's resources and do not use illegal fishing techniques. Most Cuyunons consider the migrant fishermen outsiders because of language and cultural differences. They also label all migrants as *ilegalistas*, because many use cyanide, are ambivalent to local conservation efforts, are well connected and protected by the political elite involved in the live fish trade and are dangerous due to their illicit fishing activities.

As a result of stigmatization, fear and resentment, migrant communities mostly keep to themselves in small, isolated settlements and are not integrated into Cuyo society. This leads to simmering social conflict that poses serious problems for conservation efforts. The migrants were purposely excluded from participating in the establishment of community-based marine protected areas and were targeted by law enforcement. However, their exclusion ultimately undermined the success of the marine protected areas because the migrants did not understand why the area was being protected, or the rules and regulations by which they were supposed to abide (D'Agnes, pers. comm. 2006).

WHAT MIGRATION TRENDS CAN WE EXPECT IN THE FUTURE?

The natural world currently faces impacts from anthropogenic forces on a scale greater than ever before. Some of these forces may result in large-scale migration patterns that have not occurred previously. Globalization is a huge driver of migration as global communications and geographical access expand, investment flows globalize and trade is liberalized. At the same time, the world's population continues to grow, and poverty deepens in several parts of the developing world. Some of the root causes that are likely to drive future increases in migration are outlined below.



CREDIT: © WWF / Judy Oglethorpe

Children near Fianarantsoa, Madagascar, where continuing population growth is contributing to environmental degradation and migration

4.1 Population and Consumption

Global human population is projected to grow from 6.5 billion in 2005 to approximately 9.1 billion in 2050 (UN 2005). All of this net population growth will be in developing countries, the majority occurring in Asia and Africa (see Section 2). Agricultural production and the consumption of natural resources already exceed sustainable levels in many areas around the globe, with developed countries consuming at much higher per capita rates than developing countries. These consumption rates continue to rise, particularly in the so-called BRIC countries (Brazil, Russia, India and China). By 2050, the BRICs, the United States and Japan could have the six largest economies in the world (Wilson & Purushothaman 2003). This growth will be accompanied by huge demands for natural resources: the impacts of increased resource consumption by China are already being felt around the world.

The combination of growing population and rising consumption levels will lead to an increased global footprint and further environmental degradation in many areas, with declines in agricultural and natural resource productivity. Technological breakthroughs may be able to offset this effect to a limited extent, for example through the intensification of agriculture or greater economies of scale in production. But many local populations may be forced off their land, with fewer and fewer rural places to move to and greater pressure on the remaining natural areas. Effects of growing population, increasing consumption levels and environmental degradation will be confounded by the following additional factors.

4.2 Globalization and Trade

Some of the case studies discuss the impacts of international trade on local areas. As the move toward trade liberalization through world trade agreements progresses, further impacts on biodiversity are likely. Lower transaction costs of international commerce will contribute to an expansion of trade in agriculture, mining, forestry and energy products. This could have positive or negative impacts on biodiversity and people, depending on existing land uses, tenure and production systems. For example, the expansion of soybean agriculture in Mato Grosso and livestock production throughout the Brazilian Amazon are driven by international demand and Brazil's comparative advantage in production of these commodities. Increased commercialization could result in displacement of local subsistence farmers to more marginal areas, or an influx of labor. Elsewhere, existing production systems will be less competitive and will be abandoned. There could be gains for biodiversity, but it depends on the land use that replaces them. If people can no longer gain a living from an old production system (e.g., mining), they may migrate to frontier areas and turn to subsistence agriculture or exploit natural resources, as in the Copperbelt region of Zambia. Changes will often be difficult to predict and even more difficult to control.

4.3 Climate Change

In some places, climate change will make conservation efforts and the survival of species, genetic material and ecological processes much more challenging (Hansen *et al.* 2003, Lovejoy & Hannah 2005). As climate change advances, major shifts in agricultural production systems and natural resource productivity are likely across regions and continents. Biodiversity will be faced with having to adapt not only to a changing climate per se, but also to changing human pressures. Some areas will decline in their ability to support people, while other areas may improve. It is likely that there will be large human population movements in response to these changes, especially in developing countries where people have less access to the education, resources and technology needed to adapt their food production systems (da Fonseca *et al.* 2005, McLeman & Smit 2006).

CREDIT: © WWF-Canon / Jikkie Jonkman

Settlements such as this Bajo fishing community in Sulawesi, Indonesia, are very vulnerable to sea-level rise.

In addition, a very large number of people live in coastal areas where risk of rising sea levels and frequency of extreme weather events are increasing due to climate change. The low-elevation coastal zone (less than 10 meters above sea level) contains one-tenth of the world's population, about 600 million people, of whom 360 million are living in urban areas (McGranahan *et al.* 2006). Countries with the largest numbers of people in this zone are China, India, Bangladesh, Indonesia, Vietnam, Japan, Egypt, the United States, Thailand and the Philippines. Many small island states have very high proportions of their populations in this zone, such as the Maldives, 100 percent of whose population resides in the low-elevation zone. Furthermore, at least 180 million people (at early 1990s population levels) are exposed to a one-meter rise in sea level; the scale of the impact will depend on future trends in climate change mitigation and adaptation, including coastal defenses (Nicholls & Lowe 2006). Many coastal areas around the world (e.g., Bangladesh, Fiji, Tuvalu) are already being affected as the rising sea level is beginning to force people to move to higher ground. Expensive coastal defenses may protect low-lying settlements in developed countries, but these will be much less affordable in developing countries

CREDIT: © WWF-Canon / Michael Gunther

Trade liberalization will have large impacts on production systems, migration and biodiversity.

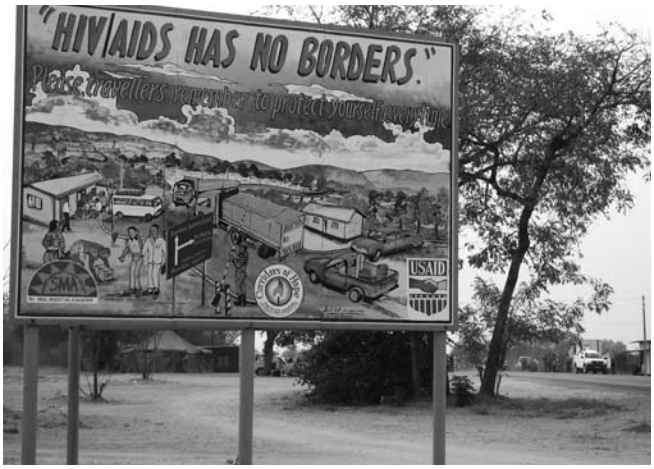
Box 6. Africa's Vulnerability to Climate Change

If current climate trends continue, climate models predict that by 2050 Sub-Saharan Africa will be warmer by 0.5 to 2.0°C and drier, with 10 percent less rainfall in the interior (Nyong & Niang-Diop 2006). There will likely be an increase in frequency of extreme events such as droughts and floods. Impacts include increased water shortages in some countries, with a serious decrease in flow of the Nile and certain other major rivers. There will probably be severe impacts on crop productivity and fisheries. Incidence of disease is likely to be affected: for example, malaria will expand in some areas, such as southern Africa and the East African highlands. Sea-level rise will have large impacts on people living at or near sea level, and there will be huge effects in large cities. In West Africa, for example, 40 percent of the population already lives in coastal cities, and the 500-km coast between Accra (Ghana) and the Niger delta (Nigeria) is expected to become a continuous urban megalopolis, with more than 50 million people by 2020 (Klein *et al.* 2002). Very few African countries have the resources to develop expensive coastal defenses. Sea-level rise may also result in inundation and salinization of agricultural soils in low-lying coastal plains. Of all continents, Africa has the lowest adaptive capacity, and it is extremely vulnerable because of high poverty levels.

and may not be entirely effective in developed countries (as was seen when New Orleans was hit by Hurricane Katrina in 2005). Climate change-induced migration is likely to occur on a very large scale and may occur suddenly in response to major events such as floods, droughts, heat waves and hurricanes.

4.4 Armed Conflict

Armed conflicts are a major cause of migration and have increased in number throughout the world over the last century. Most are now civil wars rather than wars between nations. They have become increasingly unstructured and difficult to predict, with greater impact on civilians, including women and children (McNeeley 2000, Reno 2001). They are driven by a variety of motives, often involving a struggle to control natural resources such as oil, gold, diamonds, water and timber (Shambaugh *et al.* 2001). As pressure on land and resources increases in the future, it seems likely that conflict and war will continue to be a major factor in displacing people both internally and across borders.



CREDIT: © WWF / Judy Oglethorpe

Migration can accelerate the spread of emerging diseases such as HIV/AIDS.

4.5 Emerging Diseases

Migration to remote areas such as forest frontiers for wildlife and bushmeat trade brings people into greater contact with wildlife and increases the risk of new diseases jumping from wildlife to people and livestock, as happened when simian immunodeficiency virus jumped from chimpanzees to people and mutated into HIV (e.g., Keele *et al.* 2006, Karesh *et al.* 2005). With the emergence of new diseases such as severe acute respiratory syndrome (SARS) and avian influenza, there may be new migrations of people trying to escape infection or moving because of the consequences. AIDS is already causing many small-scale movements of people in parts of Africa, and this is likely to increase as the epidemic progresses in Africa and beyond. In some places, such as parts of western Kenya, so many adults have died that the surviving children and elderly relatives have been forced to abandon their land and move to other villages or towns, placing additional pressure on resources (Dwasi, pers. comm. 2006). The movement of people ill from opportunistic infections of AIDS has also been reported to occur from cities to rural areas, where the sick return to their area of origin to seek care until they die. This is causing increased pressure on natural resources, such as medicinal plants to treat opportunistic infections, water for washing patients, and fuelwood to keep patients warm and to boil water (Chibememe 2004).

CHAPTER 5

DECIDING WHETHER AND HOW TO INTERVENE

5.1 Understanding the Situation

Types of interventions to reduce adverse impacts on biodiversity caused by migration are outlined in Section 6. However, before selecting interventions it is important to have a sound understanding of all the forces and their inter-relationships, and to be able to predict direct and indirect consequences of possible interventions on people and biodiversity. Armed with this knowledge, conservation practitioners and their partners are in a stronger position to decide whether to intervene, and if so, how.

Each situation is governed by a complex set of political, economic, social, cultural, institutional and environmental factors, including the push and pull factors that determine whether migration will take place and its nature. However, migration is just one result of this complex set of factors that have many other consequences on biodiversity and people's lives; it should not be viewed in isolation. We have to take a holistic approach to understanding and working out the most effective interventions.

Since each situation is unique, there is no single blueprint that can be applied to prevent migration or avoid its environmental impacts. An intervention that works in one area may not be effective in another, so interventions must be carefully selected for each situation. Often a set of complementary interventions is needed. And sometimes there is nothing the conservation sector can do to mitigate a migration impact—conservation efforts may be better invested in other activities for the time being.

As part of the process in planning conservation interventions, it is helpful to construct a conceptual framework that shows biodiversity, migration impacts, direct threats, push and pull factors, and their proximate and root causes. Figure 3 illustrated the basic push and pull factors of migration. Figure 4 builds on Figure 3 and shows a generalized conceptual framework for migration. On the right is biodiversity, and to its immediate left, the stresses that migration can cause. To the left of the stresses are the direct threats that result from migration. The dotted line boxes on the left-hand side of the figure contain push factors in areas of origin and pull factors in destination areas, including direct drivers in the shaded boxes and their root causes to their left. This theoretical framework does not show all migration factors, but it provides a way to illustrate the complex web of interactions underlying most migration situations.

We collaborated with WWF staff in Madagascar to adapt their existing conceptual framework for migration in the Spiny Forest to the format in Figure 4. The Spiny Forest framework is shown in Figure 5 (found in Annex 2) and includes the interventions selected in the Spiny Forest to reduce the effects of migration. Although it is beyond the scope of this publication to go into detail on methodologies for selecting appropriate interventions, Annex 2 provides references for guidance in this fast-evolving area and shows some individual results chains for interventions in Madagascar.

5.2 Coordination Across Sectors

Decisions about interventions should be based on a vision developed by state and civil society of what migration policy they want in areas of high biodiversity. Developing this vision requires coordination across and among sectors: government departments, community-based organizations, nongovernmental organizations (NGOs), academic institutions, the private sector and others. It also requires collaboration across multiple disciplines. Conservation

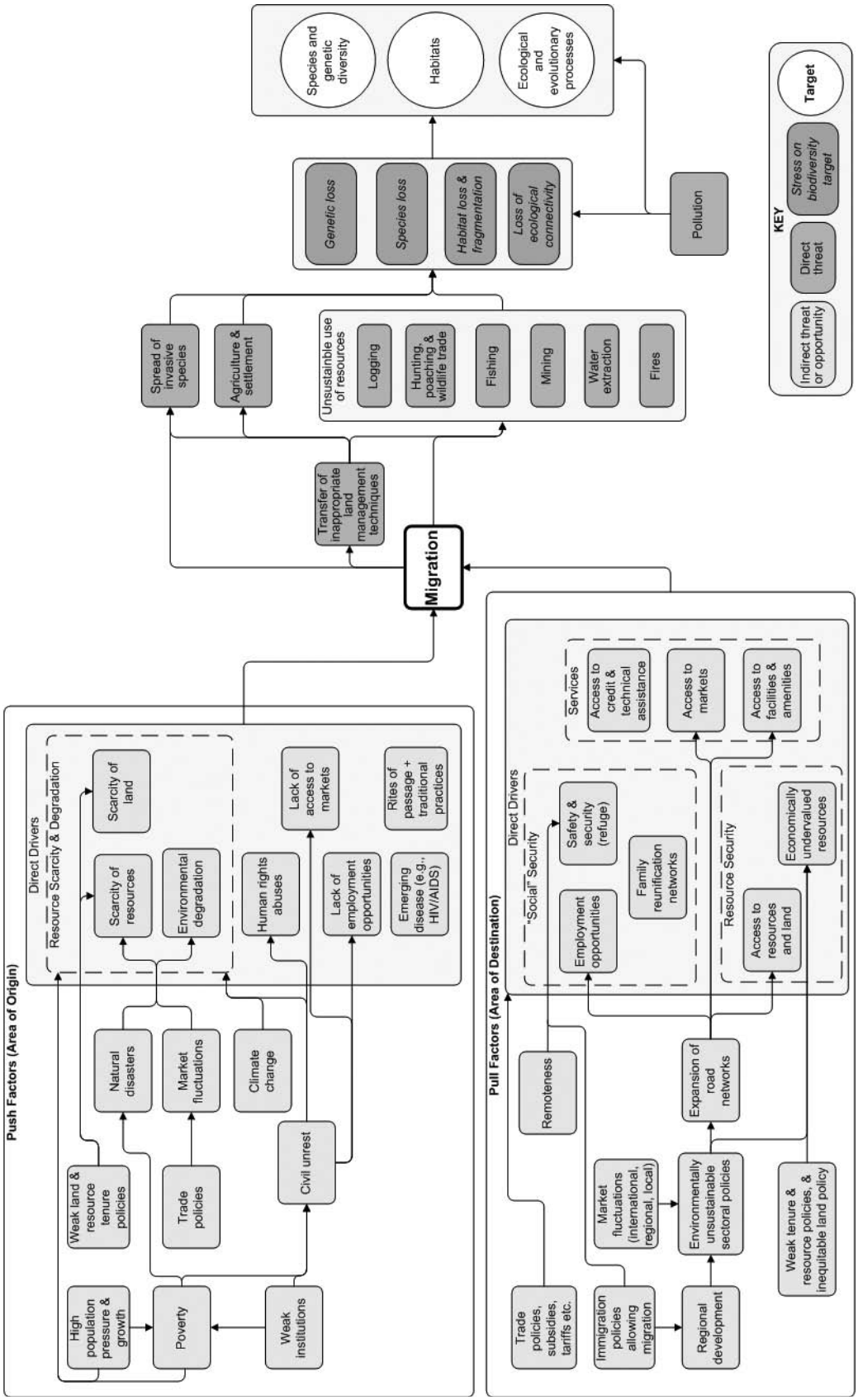


Figure 4. General conceptual model depicting push/pull factors and biodiversity impacts related to migration

practitioners need to partner with organizations working in agriculture, transport, health and other fields. It takes time to learn each other's technical language, find common goals and develop trust. In cases of sudden-onset migrations caused by disaster and armed conflict, it helps to have existing relationships with relief and development organizations (see Section 6.7).

There are many examples of cross-institutional partnerships. For example, in the Atlantic Forest in Brazil, conservation organizations are working with organizations of the landless such as the Movement of Rural Landless Workers (Cullen *et al.* 2005). The Zambian Forestry Department is developing a joint forest management model in partnership with local chiefs in the Miombo Ecoregion; chiefs hold traditional rights in forested areas located outside of government-controlled forest reserves (van de Veen 2005). And WWF and CI work with health partners in integrated population-health-environment projects in places such as the Philippines, Nepal, Kenya, Madagascar, Cambodia and the Congo Basin to provide basic health services and voluntary family planning in areas of origin and destination.

CREDIT: © WWF / Judy Oglethorpe

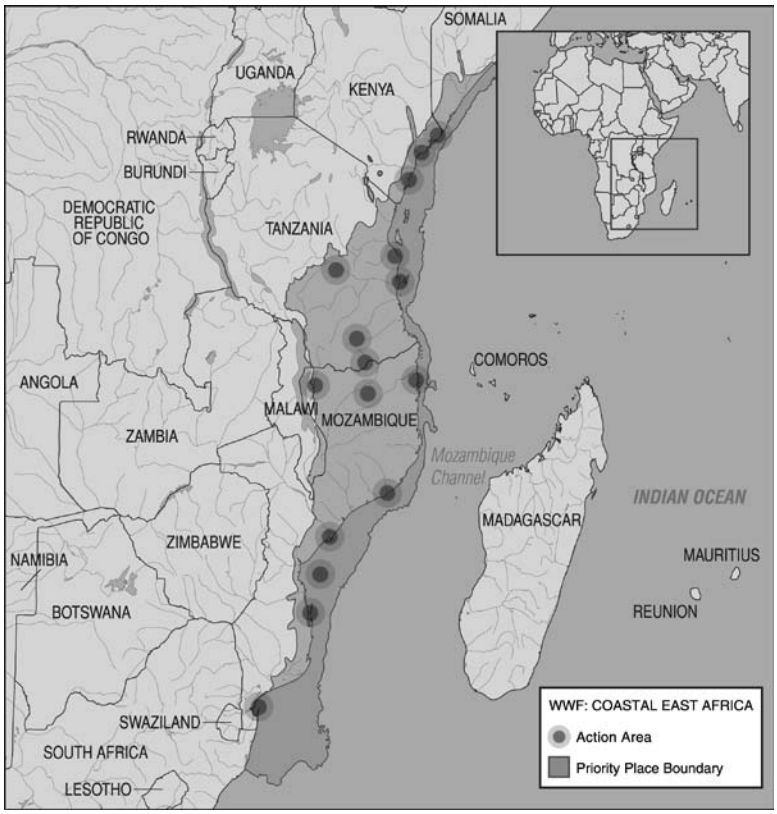
In Madagascar, conservation organizations partner with local communities to support local planning and strengthen community rights in forests.

5.3 Working at Multiple Scales

We also need to work at different scales. In addition to working at the local level, it is important to participate in

CREDIT: © WWF / Kiunga Project

WWF is working at local level with fishermen in Kiunga, Kenya, to promote more sustainable fishing techniques.



On the East African coast, countries with shared fisheries and transboundary protected areas are exchanging information and developing collaboration on marine resource management.

national policy processes and ensure that environmental impacts are thought through at the planning stage. In some cases we also need to work at continental and global levels—for example, on agriculture, fisheries, minerals and energy. A multilevel approach can be very important to leverage results. On the East African coast, where migrant fisherman from both the region and overseas compete with local fishermen, coordinated interventions at several levels could help:

- ***National level:*** legislation on zoning to strengthen local fishermen's rights and exclude migrant fishermen from certain zones
- ***Local level:*** in the area of destination, zoning for no-take zones, artisanal fishing and commercial fishing; and in areas of origin, development of alternative livelihoods and creation of no-take zones to increase fish productivity
- ***Regional level:*** cooperation between neighboring countries to manage shared fish stocks, including quota setting, and cooperation on controlling illegal fishing
- ***International level:*** advocacy with foreign fishing nations in Europe and Asia, which are competing for fish with local fishermen in East Africa; technical assistance to strengthen national capacity to control illegal fishing

5.4 Time Frame for Results

Some interventions can yield results very quickly: for example, introduction of fuel-efficient stoves to reduce impacts of fuelwood collection by migrants. Other interventions may take much longer. The provision of family planning services, for example, takes many years to show the effects of slowing population growth and the rate of environmental degradation. Yet if it is not part of a package of interventions in communities with high fertility rates that are prone to migration, gains from shorter-term interventions may be short lived. The population may continue to grow, forcing people to move out in 10 or 20 years due to a decline in per capita land, resource and food availability. It is important to design a suite of interventions that will give both short-term and longer-term results that can be sustained into the future.

INTERVENTIONS TO REDUCE MIGRATION IMPACTS ON BIODIVERSITY

This section reviews a broad range of possible interventions to prevent migration, influence its course or reduce adverse impacts on biodiversity and local residents—a rudimentary "what's in the tool kit."

6.1 General Typology of Interventions

An individual intervention can be characterized as:

- Influencing migration itself versus reducing impacts
- Working at the policy versus field level
- Focusing on the area of origin versus area of destination
- Addressing the future versus the present situation

Table 4 shows the main types of intervention. Many of these are discussed in the following sections, with illustrations from the case studies and other examples.

The ideal situation in many cases is to prevent migration. However, this often means addressing the root causes, which may require changing national policy and may be beyond the scope of conservation organizations. Therefore, it may be necessary to focus on actions in the field to prepare for or reduce the impacts of migration in areas of destination. If there is more time, with more anticipation and longer-term planning, it may be possible to tackle the root causes and enable people to stay in their areas of origin (de Sherbinin & Freudenberger 1998).

6.2 Who Should Use These Interventions?

Possible interventions cover a wide range of levels, from global to local. Some are appropriate in areas of origin, others in areas of destination, and some at the policy level. Who should implement them, and where? Table 4 shows the types of interventions, the scale and place at which they normally operate, and the type of person who might be involved in planning and implementing them. We have focused on the conservation sector and have not listed other sectors that would also be involved, though in many cases the conservation sector would not do this work alone.

Table 4. Types of possible migration intervention by scale and sector

	Global	Regional	National	Landscape	Local
Policy Level	■ Influence global trade policies ■ Influence immigration policy for international migration ■ Influence indigenous people's policy ■ Provide inputs to international conventions that may influence the biodiversity/ migration nexus	■ Promote regional economic development policies that are environmentally and socially sound	■ Promote socially and environmentally sound economic development policies ■ Promote environmentally and socially sound sectoral policies (e.g., trade, agriculture, migration, transport, conservation, water, land, immigration)	■ Develop environmentally and socially sound landscape strategies and plans	■ Promote sound local policy and bylaws for environmental management and natural resource use
Areas of Origin			■ Provide assistance in commercialization of products ■ Promote technologies for more efficient natural resource use ■ Stimulate private sector development	■ Promote development of alternatives to unsustainable resource use ■ Improve physical market access for sustainably produced products ■ Foster communication about true conditions in the area of destination ■ Promote climate change adaptation	■ Improve access to land, resources, credit, technical assistance ■ Improve livelihoods through integrated rural development and general economic development ■ Improve social and economic infrastructure, such as education and health ■ Improve access to family planning and reproductive health services

Table 4. *(continued)* Types of possible migration intervention by scale and sector

	Global	Regional	National	Landscape	Local
Areas of Destination			■ Zone areas for conservation, resource extraction and human settlement ■ Restrict/ carefully plan road development ■ Create or expand protected areas	■ Zone areas for conservation, resource extraction and human settlement ■ Restrict/ carefully plan road development ■ Create or expand protected areas	■ Ensure stronger law enforcement to prevent migrants from entering prohibited areas and to ensure appropriate land use in other zones ■ Encourage voluntary resettlement of migrants out of destination area with incentives (including magnet areas) ■ Strengthen land and resource tenure of existing residents to keep newcomers out ■ Limit plot size in frontier areas ■ Develop off-farm livelihood opportunities ■ Set quotas for resource extraction, promote lower-impact extraction methods ■ Provide for family planning in areas with high fertility rates ■ Provide for social services such as education and health ■ Encourage people to return to area of origin
Armed Conflict	■ Promote best practices related to conflict resources (e.g., diamonds, timber)		■ Incorporate environmental aspects in new national constitution ■ Promote sound postwar sectoral policy development	■ Encourage resettlement of displaced people and reconstruction to reduce biodiversity impacts and promote sustainable development	■ Support local community livelihoods where feasible in areas of origin ■ Mitigate impacts of refugees and IDPs ■ Promote sound environment practices in refugee and IDP camps ■ Encourage resettlement of displaced people and reconstruction to reduce biodiversity impacts and promote sustainable development ■ Promote integration of demobilized soldiers into society

Table 4. *(continued)* Types of possible migration intervention by scale and sector

	Global	Regional	National	Landscape	Local
Parties Involved	■ Global policy staff in international organizations ■ Government policy advisors ■ Policy/advocacy staff in NGOs ■ University researchers ■ Donors	■ Regional policy advisors in government organizations ■ Regional policy staff in conservation NGOs ■ Regional policy staff in international organizations ■ University researchers ■ Donors	■ Government policy advisers and planners ■ National policy/advocacy staff in conservation NGOs ■ Natural resource/tourism private sector operators ■ University researchers ■ Donors	■ Landscape planners ■ Landscape program managers ■ District government conservation/development staff ■ Protected area planners and managers ■ University researchers ■ Communication staff in government and NGOs ■ Private sector operators ■ Donors	■ Protected area managers and planners ■ Conservation/development project managers ■ Members of community-based organizations ■ Local leaders ■ Managers of credit programs ■ Private sector operators ■ Conservation/development extension workers ■ Communication staff in government and NGOs ■ Local government conservation/development staff ■ Donors

6.3 Interventions in the Case Studies

In 10 out of the 13 case studies, there was some form of migration intervention, aimed to alter migration flows in areas of high biodiversity or to mitigate their effects. Interventions had also been proposed for the remaining three cases but had not yet been implemented. The majority of implemented and proposed interventions were designed to address direct threats to biodiversity loss, such as slash-and-burn agriculture, illegal hunting, mining and other unsustainable resource use. The most common intervention was law enforcement, followed by technical support for improving agricultural practices. Because these interventions did not address the root causes of migration, they tended to be shorter-term, quick-fix types of interventions designed to reduce the immediate impact of migrants.

CREDIT: © CI / John Williams

Malagasy women in rice paddies

There appeared to be a greater understanding of the pull factors in destination areas than of the push factors in areas of origin. This disparity resulted in the development of intervention strategies in areas of destination, such as land tenure, access to resources, social services and employment. Fewer interventions were proposed or implemented in areas of origin. This may be because root causes—poverty, civil unrest, market fluctuations and natural disasters—are complex in nature and difficult to address, often requiring longer-term collaboration with non-traditional partners in political, social and economic realms. Also, conservation organizations involved in the case studies seldom had work programs in the areas of origin. Very few of the case studies had interventions in the policy arena, and those they did have were mostly proposed rather than implemented.

6.4 Policy Interventions

6.4.1 Economic Development Policies

Greater land-use planning is needed in frontier areas and areas of high biodiversity. Planning should include studies to determine the biodiversity value and land capability in different areas. Such studies would be useful, for example,

in determining where new protected areas should be established or where new roads could be built to provide access to areas suitable for agriculture. A 2005 analysis of agricultural suitability in forested portions of CI's biodiversity hotspots and tropical wilderness areas revealed that these lands are largely unsuitable for agriculture, either commercial or subsistence (Gorenflo & Brandon 2005). By incorporating both biological and social economic data, planning can adequately address biodiversity and agricultural production in a coordinated manner (Brandon *et al.* 2004). This is a first step in promoting a more rational economic development of frontier areas.

Poverty Reduction Strategy Papers (PRSPs) in low-income countries are a formalization of national development plans for poverty alleviation; they were initiated in 1999 with support from the World Bank and the International Monetary Fund. Sound PRSPs that promote poverty alleviation through sustainable livelihoods in areas of origin, and do not result in displacement of people (for example by large-scale developments or excessive focus on large-scale agriculture), should help to reduce out-migration.

6.4.2 Sectoral Policy

Sectoral policies related to land, agriculture, transport, water, migration, energy, mining and forestry can have large impacts on migration, for example through the creation of job opportunities and displacement of people for sectoral development projects. Conservation organizations should participate in long-term planning processes, including strategic environmental assessments (SEAs), to reduce adverse impacts from sectoral policies. This requires having information on likely impacts available in time for it to be used; providing technical inputs into SEAs, environmental impact assessments and feasibility studies; and advocating for sound development. The paragraphs below outline impacts from a selection of specific sectors.

Migration policies control, encourage or discourage migration. Establishing an effective legal framework and migrant registration is one way to try to regulate migration, both within and between countries. For example, Ecuador has tried to control immigration to the Galapagos Islands through the Special Law for the Conservation and Sustainable Use of the Galapagos Province. The law defines permanent residents as those born in the Galapagos and those who had lived there for more than 5 years before 1998, plus their spouses and children. It establishes registration mechanisms and makes new temporary permits available only to those whose employers can justify a need for their special skills. In addition, it limits the amount of time tourists and transient visitors can stay in the islands. However, serious problems still exist with its enforcement (Bremner & Perez 2002, Kerr *et al.* 2004). Another example where policy could greatly affect migration and its impacts is on the border between Mexico and the United States. Defenders of Wildlife (Segee & Neeley 2006) recommend the following U.S. policy development and implementation measures to reduce environmental impacts of illegal migration in this area:

- Integrate environmental considerations into any legislation addressing immigration reform.
- Use low-impact infrastructure where appropriate to mitigate the environmental effects of undocumented migration and other illegal activities in the short term.
- Fund U.S. Border Patrol commitments to environmental protection and mitigation.
- Urge the U.S. Congress to use more high-tech surveillance methods.
- Improve communication between the U.S. Department of Homeland Security and the affected communities about the activities they are planning to undertake.

Land policies that ensure adequate and secure access to land and natural resources—whether in the form of private ownership, long-term lease or communal ownership/control—can play a major role in helping to prevent out-migration from areas of origin. On the other hand, land distribution and tenure policies that enable a small number of people to control most of the usable agricultural land tend to lead to out-migration. Various policy options can improve access to land and thereby help people stay in areas of origin. Such options have been widely recommended by development economists and international development agencies for many years as a way to reduce poverty, but have not always been implemented due to the entrenched political opposition and power of large landholding interests. Land policy is also

Box 7. Land Policy in Mozambique

After the end of the last war in Mozambique, the government started allocating large areas of land for commercial purposes to restart the war-torn economy. Many local people were still absent as refugees or IDPs. With the coming of peace, some returned home to find that their traditional lands had been allocated to incomers and development was already taking place. A new land policy was created in 1995 (and a land law was subsequently passed in 1997) that recognized the rights of local people to their traditional lands and resources. It also enabled communities on still-unallocated land to form associations to gain communal titles and, if desired, to enter into joint ventures with the private sector (Frey 2004).

CREDIT: © WWF / Judy Oglethorpe

Land policies can exert major influences on migration.

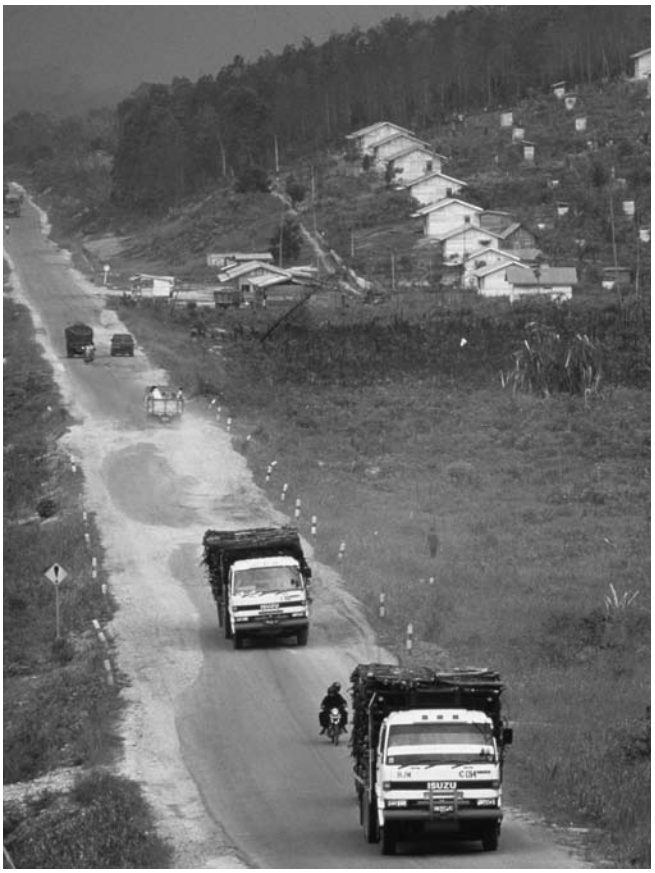
important in areas of destination. For example, securing land rights of residents in potential destination areas can reduce the likelihood of migrants moving in and help secure livelihoods of local residents.

Agricultural and wildlife policies have profound impacts on biodiversity. In several countries in southern Africa, wildlife and veterinary policies allow local communities to benefit from wildlife. In many cases, particularly in marginal areas, wildlife management has proved to be more profitable and environmentally favorable than farming and livestock husbandry (Osofsky *et al.* 2005). Community-based natural resource management can help to secure livelihoods and prevent out-migration. In other cases, agricultural policies have negatively impacted wildlife through human migration. For example, in Botswana, the Tribal Grazing Land Policy opened up large areas of the Kalahari to settlement and livestock, resulting in competition between wildlife and cattle for water and fodder. The accompanying veterinary policy for foot-and-mouth control resulted in a network of fences that compartmentalized much of the country and disrupted wildlife migration patterns. To reduce these impacts, land that had been set aside as reserved land for the future was used to create wildlife management areas. These areas were often adjacent to parks and reserves and helped to maintain wildlife corridors between wet and dry season wildlife areas (Carter 1983).

Transportation policies determine the location of new and upgraded road networks, which greatly influences the direction and pace of frontier settlement and therefore can greatly impact biodiversity (for example, roads in the Amazon and Congo basins). It may be possible to influence transportation policies to divert roads away from areas of high biodiversity. In Mozambique, for example, after an environmental impact assessment was conducted, a new link in part of the main national north-south road was diverted to the west of Gorongosa Mountain to avoid running between the mountain and Gorongosa National Park. The mountain provides the only perennial water source for the park, and severing the park from the mountain by a national road would have caused serious impacts.

Water policies can greatly affect settlement and migration patterns. In areas where water is not easily accessible, provision of water can open areas up to settlement and human activity. Policymakers should therefore consider avoiding water provision in sensitive areas.

Construction of large dams for water supply, irrigation and power has resulted in displacement of approximately 40 to 80 million people worldwide (World Commission on Dams 2000). Sometimes people have resettled higher up in the catchment and cleared new land for agriculture, resulting in habitat destruction and fragmentation, loss of



CREDIT: © WWF-Canon / Mark Edwards

Transmigration settlements develop alongside the logging road leading from the forest to the pulp mills, with oil palm plantation in the background; Sumatra, Indonesia.

CREDIT: © CI / Haroldo Castro

Local ranchers herding cattle in the Pantanal, Mato Grosso State, Brazil. Agricultural subsidies, trade tariffs and tax incentives can have varying impacts on the environment—positive or negative.

fauna and flora, and land degradation that can affect the dam downstream through sedimentation and changes in water regime. Dam development also attracts people from outside for construction and longer-term development such as irrigated agriculture, which can also have environmental impacts. The World Commission on Dams (2000) has produced policy principles for water and energy development, and criteria and guidelines for good practices covering social, environmental, economic, cultural and governance issues related to dams.

6.4.3 Subsidies, Trade Tariffs and Tax Incentives

Section 3.3.1 outlined some of the negative impacts of subsidies and trade tariffs on biodiversity through their influences on migration. But subsidies—in the form of incentives for settlement in urban areas or in abandoned agricultural lands—can be positively applied to reduce pressure in areas of ecological importance, particularly when production remains viable, but costs of establishment or production are high.

Changes in the agricultural subsidy policies of key developed nations could have large effects on migration, with varying impacts on the environment—some positive and some negative—as production systems shift in response to market changes. Such changes are likely in the future as trade liberalization progresses. Careful thought is needed to predict impacts, and try to avoid large-scale negative social and environmental impacts. (See Section 6.5.2 for the case of reducing environmental impacts of declining EU sugar subsidies in Fiji.)

Land taxes can ensure that land in large holdings is used productively and potentially provides more employment opportunities for those with little land. Often, land that is part of large holdings is not efficiently used, contributing to low agricultural output, rural poverty, lack of employment and out-migration to frontier areas, where it is a driving force behind rapid deforestation. For example, in Guatemala, Bilsborrow and Stupp (1997) found that half of the land in large landholdings that they sampled went unused. In other cases, land is used in extensive forms of agriculture that provide low incomes per unit of land area and little employment.

A presumptive income tax on agricultural land would help stimulate large landowners to use the land, or use it more intensively, to produce output and income to cover the tax. The tax can be progressive—higher per hectare on larger landholdings. The stimulation of more intensive forms of land use (e.g., higher-value crops, such as vegetables vs. grains, or crops vs. cattle) could also generate more rural employment, reducing poverty. Increasing access to land or to employment could reduce incentives to out-migrate from rural areas, which would reduce pressures on poten-

Box 8. Protecting the Rights of Indigenous Peoples in the Peruvian Amazon

In the Amazon headwaters in Peru, there are several groups of indigenous people living in voluntary isolation. However, in some areas their traditional way of life in the forest is threatened by the incursion of seasonally migrant illegal loggers, as well as the potential development of economic activities such as gas, oil and gold extraction. The incursion of outsiders makes indigenous people in voluntary isolation vulnerable to loss of their natural resource base, as well as illnesses from the outside to which they have no immunity. In 2006, the Peruvian Government approved a new law for Indigenous People in Voluntary Isolation. This legislation, advocated by a consortium of organizations including the national indigenous federation Asociación Interétnica de Desarrollo de la Selva Peruana, Racimos de Ungurahui, Ibis and WWF, is fundamental not only to ensure the rights of these vulnerable indigenous groups, but also to protect the physical integrity of the Territorial Reserves where they live. In addition to policy development, WWF's Peru Program Office is working in the field to address illegal logging in key areas such as Alto Purus National Park, and by supporting patrolling efforts along the borders of the territorial reserves that abut the park (given that, by definition, patrols cannot enter the Territorial Reserves) (Soudre pers. comm. 2006).

tial areas of destination. It can help reduce social inequities and economic inefficiency in resource use. However, any such tax requires a strong political will, good governance and adequate institutional capacity to implement it.

Such a tax should take into account land characteristics and be lower for more marginal areas not suitable for agriculture, such as steep slopes, poor soils and wet or dry areas. Land with high biodiversity should be exempted to encourage private landowners to protect it; alternatively, it could be purchased and turned into public protected areas. Otherwise, the tax would force private landholders to clear and use these areas.

6.4.4 Conventions and Agreements

Several international conventions and agreements have potential to influence the impacts of migration on biodiversity. These include conventions directly concerning the environment and natural resources, such as the Framework Convention on Climate Change. The degree of success of this convention will influence the scale of migration driven by climate change (e.g., movement from areas where economic productivity falls, and from coastal areas affected by sea-level rise and extreme weather events; Section 4.3). Regional fisheries agreements have a strong influence on migratory fishermen and their impacts on fish stocks.

Other conventions have indirect impacts on migration and biodiversity. The World Trade Organization (WTO) agreements have huge potential to cause migration-related impacts, as outlined in the sections on subsidies and trade tariffs—although the effects on biodiversity are variable, sometimes causing more pressure and sometimes less. Environmental advocacy is critical during the process of developing new conventions and agreements if there are likely to be environmental impacts, including those indirectly induced by migration.

An important convention relating to the work of many conservation organizations is the International Labour Organization (ILO) Convention 169, Concerning Indigenous and Tribal Peoples in Independent Countries (ILO 1989). This convention covers rights of indigenous peoples over lands, territories and natural resources that they have traditionally owned, occupied or used. It declares "the right to decide their own priorities for the process of development as it affects their lives, beliefs, institutions and spiritual well-being and the lands they occupy or otherwise use, and to exercise control, to the extent possible, over their own economic, social and cultural development. In addition, they shall participate in the formulation, implementation and evaluation of plans and programs for national and regional development which may affect them directly" (Article 7.1). Hence, this convention can help protect indigenous peoples' rights in relation to others who may want to move into their territories.

6.4.5 Indigenous Peoples Policy

Supportive institutional policies can create opportunities for collaborative action between conservation organizations and indigenous groups to identify common goals to protect indigenous rights within their territories, including in

CREDIT: © CI / Russell A. Mittermeier

Local woman in Nosy Komba, Madagascar

CREDIT: © WWF-Canon / Martin Harvey

BaAka woman collecting forest products in Dzanga-Sangha, Central Africa

relation to migration. WWF's policy on indigenous peoples recognizes the rights of indigenous peoples to the lands, territories and resources they have traditionally owned, occupied or used, as laid out in the ILO convention. These include the right to exert control over lands, territories and resources; establish appropriate management and governance systems; and maintain cultural and intellectual heritage. WWF's policy also recognizes indigenous peoples' rights to determine development priorities and to require states to obtain their free and prior informed consent before approving development projects in their territories. In instances where multiple local groups claim rights to resources in indigenous territories, WWF recognizes the primary rights of indigenous peoples based on historical claims and long-term presence, with due regard for rights and welfare of other legitimate users (WWF 1996).

CI's policy on indigenous peoples recognizes and supports their rights to maintain traditional knowledge, institutions and practices that are linked to managing and monitoring the biodiversity and ecological systems they depend on and that form part of their cultural patrimony (CI 2003). In this policy, CI recognizes that there are overlaps in lands set aside for legally designated parks and lands that are customarily owned or used by indigenous peoples. CI commits to collaborative management initiatives that recognize customary uses while ensuring natural resources are not depleted, and that actively involve indigenous communities in planning, zoning and monitoring.

6.5 Field-Level Interventions in Areas of Origin

6.5.1 Improving Access to Land and Resources

Granting poor people rights over property, land and resources can decrease migration, as rights are "formalized" in a society. It involves not only having good policy, but having capacity and political will to implement it effectively. For example, between 1982 and 1996, the Institute for Liberty and Democracy worked with the government and multisectoral stakeholders to change Peru's property system, giving 6.3 million Peruvians below the poverty line the right to own real estate (valued at $2.2 billion). Once the government had legally recognized and conferred these rights and assets to the poor, land-related conflict decreased and people were tied to one address, making them less likely to migrate (Institute for Liberty and Democracy 2006).

6.5.2 Improving Resource Use

In places where local communities have insufficient natural resources, it may be possible to find alternatives or promote more efficient resource use to reduce environmental degradation and encourage people to stay. For example, in parts of the Spiny Forest in Madagascar, one of the main causes of environmental degradation is the harvesting of fuelwood. In some rural areas, introduction of fuel-efficient stoves is helping to reduce pressure on the forest, as well as improving the lives of women, who used to spend considerable time and energy collecting firewood. There are plans to increase plantation production to supply fuelwood to urban centers; their fuelwood consumption currently places considerable pressure on the forest.

In Fiji, Oxfam International is recommending alternative uses for sugarcane to try to maintain livelihoods of sugar farmers and prevent them from migrating to other areas. The EU is poised to reduce Fiji's guaranteed sugar price (in response to action by the WTO). It is estimated that sugar directly supports 25 percent of Fiji's active labor force, and

250,000 people (31 percent of the island's population) are reliant on the sugar industry (Deverall & Lennon 2005). The threat of falling prices, coupled with an expensive and inefficient production system and insecure land tenure for small farmers, poses a serious risk that many people could move from the cane fields to the coast to seek alternative livelihoods such as fishing, where they would exert unsustainable pressure on marine resources (Rupeni, pers. comm. 2005). Hence Oxfam is proposing that sugarcane be used to produce electricity (from bagasse that remains after sugar has been extracted) and ethanol (from cane juice). In addition to maintaining livelihoods, this use of cane could partially replace expensive imported fossil fuels and hence save foreign exchange. Moreover, sugar growing is a carbon-neutral activity, so Fiji could sell carbon credits to the EU under its Emissions Trading Scheme. This activity would also reduce Fiji's own net carbon emissions: as a low-lying island state, Fiji is vulnerable to climate change induced sea-level rise (Deverall & Lennon 2005).

6.5.3 Improving Livelihoods

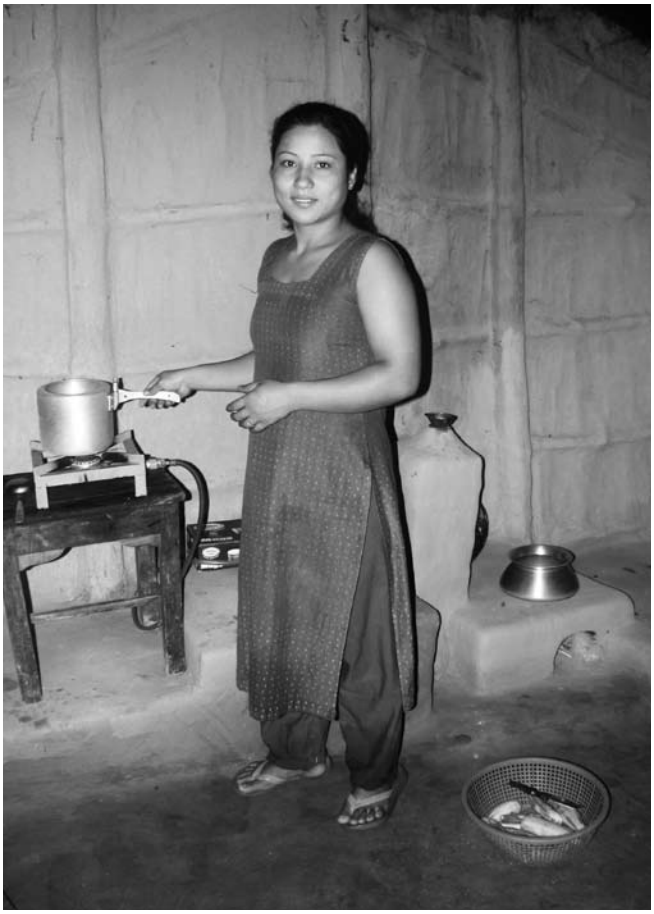
Improving livelihoods can increase rural people's incentives to remain in areas of origin. One way to do this is by improving local infrastructure. For example, small-scale

CREDIT: © WWF-Canon / Zeb Hogan

Young boy with fish on the banks of the Tonle Sap River, Cambodia

CREDIT: © WWF / Judy Oglethorpe

Woman stirring cattle dung into a household biogas plant near Chitwan National Park in the Terai, Nepal



CREDIT: © WWF / Judy Oglethorpe

Replacing fuelwood with biogas in the home greatly reduces pressure on forests and lowers the incidence of respiratory disease in women and young children; Terai, Nepal.

irrigation projects in areas of low or seasonal rainfall (e.g., Ruiz & Bilsborrow 1990 on rural Ecuador), subsidizing fertilizer inputs or promoting the production and use of organic fertilizers can have this effect. However, such subsidies must be only temporary to avoid becoming a long-term drain on national budgets. Opening or upgrading secondary rural roads in areas of dense rural populations (without substantial biodiversity value) can also encourage people to stay. In Madagascar, this approach has been successful as it has opened up access to markets for rural populations. Other market assistance, such as promoting producer cooperatives for buying inputs and selling products, can also help improve rural household incomes.

Livelihoods can also be improved through the availability of public sources of credit and technical assistance for smallholder farmers to assist with intensification of agriculture and improved practices. In some cases, with adequate investment and technical assistance, population growth has actually been accompanied by a steady or even increasing standard of living. This occurred, for example, in the Machakos district south of Nairobi, Kenya, where population growth made possible heavy investments in terracing and tree planting, which simultaneously improved the environment and living standards over the period 1932–1991 (Tiffin & Mortimore 1992). It occurred in a favorable cultural context of a single ethnic group, the Kambi, and in a favorable geographic region—close to Nairobi on a main road so that increases in agricultural output could be easily sold. However, not all communities have these opportunities.

CREDIT: © WWF-Canon / Martin Harvey

Tourists and park guards observing a mountain gorilla in the Virungas: gorilla tourism is an important revenue earner.

Promotion of regional economic development in general can encourage people to stay in areas of origin. This may involve direct government investment in rural industry or projects, or encouraging private companies to invest in specific areas of high rural out-migration. If jobs expand in towns, non-farm employment opportunities increase for members of farm households, helping them to make ends meet and diversify sources of income, so the households can remain in situ. The expansion of infrastructure may be one of these factors.

Payment for environmental services is another method that may help to improve incomes and hold people in areas of origin, where they do not have many other prospects. Payments to farmers for environmental services on their plots have been tried with some success in Costa Rica and Brazil. Ideally, the program should be as financially self-sustaining as possible. For example, farmers can be paid modestly to conserve a specific patch of forest for some years, while freely extracting trees from other parts of their land and selling them legally. This is done under a management plan that the farmer pays for and that may be supervised by a private company rather than the government to reduce corruption.

6.5.4 Making Arrangements for Retrenched Workers

When large companies close operations and lay off large numbers of workers in areas where alternative employment is scarce, workers often migrate to rural areas and turn to agriculture or natural resource harvesting for their livelihoods. This can have sudden and serious impacts on biodiversity. In both the Copperbelt mines in Zambia and in an oil field in Gabon, WWF is working with companies to reduce impacts when production is scaled down or ends. Companies are being encouraged to make provision for laid-off workers, so they are less likely to move into the surrounding areas and exploit natural resources (wildlife, timber, fuelwood, etc.) as a new form of livelihood.

6.5.5 Improving Social Services

Provision of better social services and utilities (e.g., health facilities, education, electricity, roads and other transport) often encourages people to stay in an area. Improved education and health can increase communities' capacity for sound environmental management. Ideally, interventions that improve social services should be linked and integrated with measures to improve environmental management, in a holistic approach to sustainable development and conservation.

CREDIT: © Wayne McCallum

Part of the Population Environment program, CI partners with CARE Cambodia to deliver health services and information in rural Thma Bang district, Cambodia.

6.5.6 Providing Access to Reproductive Health and Family Planning

Natural population growth continues to be high in many rural areas in the developing world. Demographic and health surveys and other sources of data continue to find substantial unmet need for family planning in these areas. In countries with high rural fertility rates and high rural out-migration, family planning education and services are an important intervention. A number of conservation organizations have integrated health and family planning into community programs (CI 2005, U.S. Agency for International Development [USAID] 2006). Various studies are underway to examine the added value of taking an integrated approach to population, health and environment.

6.5.7 Communicating the Conditions of the Destination Area

People are always looking for better opportunities, so the frontier beckons, but life there is often much harder than many expect. Information campaigns that convey the difficulties of settlement and economic problems in frontier areas to people in areas of origin may help discourage migration to the frontier. In 2005, ProPeten, a Guatemalan NGO, launched a radio soap opera portraying people's lives on the frontier of the Maya Biosphere Reserve and their struggles for land. This program is broadcast in Q'eqchi', the language of southern Petén, Belize and Izabal. Producers plan to rebroadcast the program in the migrants' places of origin to raise awareness of the challenges of life on the frontier and the scarcity of land in the region (Grandia, pers. comm. 2005).

6.5.8 Encouraging Migrants to Return to Area of Origin

Migrants may be encouraged to return to their area of origin by improving living and environmental conditions there. There may be strong environmental reasons in the area of origin for helping them return: for example, resurrecting traditional management practices. In environmentally degraded areas migrants may be encouraged to return after environmental restoration has been carried out (for example, after sudden-onset and slower disasters). However, there may be specific challenges in restoration if the most economically active members of a population have migrated out, leaving only older people to do restoration (Morris *et al.* 1996).

6.5.9 Promoting Climate Change Adaptation

Helping people adapt to climate change may enable them to remain in areas of origin. Climate change adaptation is in its early stages, and indeed we do not yet know the extent of the likely changes; while some change is inevitable, the scale is partly dependent on how much climate change mitigation is done in the near future. Promoting community resilience and adaptation includes measures such as adopting more appropriate crops (e.g., drought-tolerant crops) and cultivating techniques for the changing conditions; altering fishing strategies; integrating indigenous knowledge and building capacity to cope with change. In coastal areas, adaptation includes assisting the natural environment to adapt and continue to provide coastal protection (such as mangroves), and in some places

CREDIT: © Rosanna Cifuentes

Guatemalan midwife and her wares

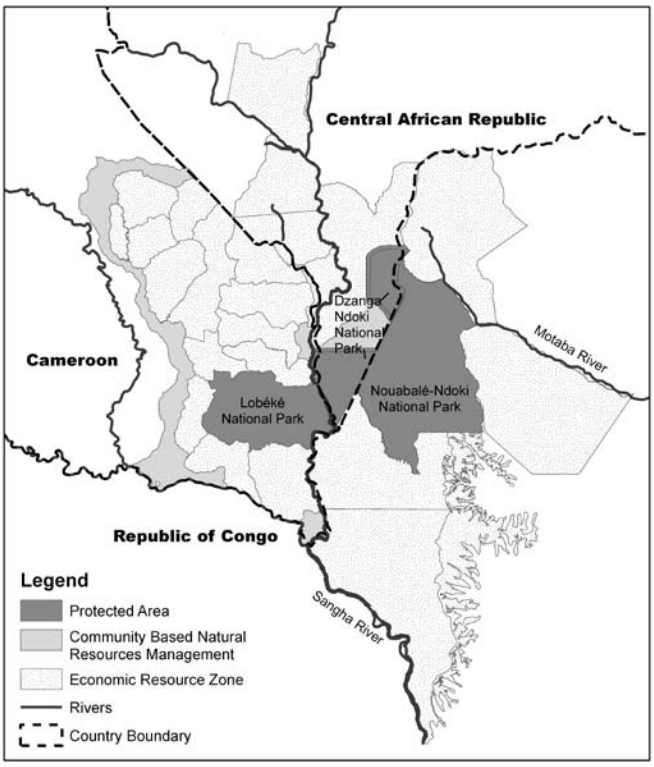
building man-made defenses against sea-level rise (Hansen *et al.* 2003, McLeman & Smit 2006, Nyong & Niang-Diop 2006). Climate change is an area that requires continued research.

6.6 Field-Level Interventions in Areas of Destination

6.6.1 Promoting Sound Zoning

Zoning of frontier and other areas can help to ensure the most appropriate land uses in different parts of the area. Planning should take into account the attributes of the area, including agricultural potential of land, economically important resources such as mineral reserves and water, appropriate areas for settlement and industrial development, water availability, access, and areas of high biodiversity value. Current and future demand for land and resources should also be assessed. In addition, a physical zoning plan should be developed that allows for optimum conservation and development. If sound planning can be done before in-migration takes place, it should be possible to avoid settlement in the most ecologically sensitive areas and direct it to areas more suitable for economic activities.

In the Atlantic Forest of Brazil, squatter groups driven by the political land reform movement have settled in unoccupied fragments of forest land, primarily near the coast, where they practice subsistence agriculture and cattle ranching. Even though forested land is technically protected by law, public policy encourages squatters to settle in forested areas because standing forest has traditionally been viewed as unproductive and unoccupied, and therefore available. In fact, extensive uncultivated land on a property has been presented before judicial courts as cause for suspension of titleholder claim (Cullen *et al.* 2005). Recently, conservation practitioners in CI conducted studies that show that the soil on these forested coastal lands has low agricultural potential. In sharing the results of soil tests, CI practitioners are currently informing the leaders of the land reform movement and recommending they direct squatters away from the remaining coastal fragments of the Atlantic Forest (Alger, pers. comm. 2005).



Zoning in the Sangha Trinational Landscape, Central Africa

CREDIT: © Carol Boender

Participatory land use planning meeting in southwestern Cambodia

In the same area, CI is working with in-country partners such as the Instituto de Pesquisas Ecológicas and small-scale farming communities to build on the law of "areas of permanent protection" (*areas de proteção permanente*), which requires farmers to maintain 20 percent of their land area in natural forests. They are working to unify plots of forest left standing on each lot and then, through broad-scale landscape planning and geographic zoning, CI plans to develop conservation corridors to enable species to move through linked forest fragments (CI Center for Applied Biodiversity Science 2000, Cullen *et al.* 2005).

6.6.2 Carefully Planning and Restricting Road Development

Roads provide access to outsiders, and for those who migrate to frontier areas, roads facilitate the use and commercialization of land, forests and other resources by

CREDIT: © CI / John Martin

Brazil Atlantic Forest, Iguaçu Falls National Park

providing access to markets. A large and growing body of literature attests to the strong effects of roads on facilitating land clearing for agriculture in frontier areas (Barreto *et al.* 2006, Kaimowitz *et al.* 1999, Pichón 1997, Pichón & Bilsborrow 1999, Rudel & Horowitz 1993, Rudel & Roper 1997). In the absence of further road expansion, there is little doubt that the process of settlement and habitat loss would slow. This is a particularly important issue in the world's last remaining wildernesses, such as the Congo, Amazon and Mekong basins.

At the same time, there is evidence that in already-populated areas that are adjacent to biologically intact areas, improving roads and access to markets for cash crops can reduce the pressure on biodiversity by improving livelihoods. In Madagascar, access to markets enables farmers to intensify production and reduces the need for slash-and-burn agriculture by local communities at the forest frontier (Freudenberger, pers. comm. 2006).

6.6.3 Creating Protected Areas in Sensitive Areas

Creating protected areas, ideally as part of an overall land-use plan, can be an effective way to channel settlement and resource extraction by migrants away from the most important biodiversity areas, while protecting the resource base of existing local communities. In larger areas, sound planning of protected area networks and surrounding land use can help to ensure species and habitat conservation, maintain connectivity and ecosystem function, afford resilience to climate change impacts, reduce threats from fragmentation and ensure local livelihoods of long-term residents, while integrating migrants where feasible.

One of the world's largest conservation area networks is in the Amazon Basin. In less than 4 years, new protected areas were created covering 4.2 percent of the Brazilian Legal Amazon under the Amazon Regional Protected Areas

CREDIT: © WWF / Zig Koch

Blue-and-yellow macaw, one of many bird species in Juruena National Park, Brazil

CREDIT: © WWF - Canon / Olivier van Bogaert

Transboundary patrol with confiscated wildlife, Cameroon

program (equivalent to an area almost the size of the United Kingdom). These additions brought the coverage of protected areas in the Brazilian Legal Amazon in mid-2006 to 18.7 percent, including state and federal strict nature protection areas and sustainable use areas of all categories (Instituto Socioambiental 2006, with updated information from Perl, pers. comm. 2006). An additional 20.7 percent of the area has been designated or is in the process of designation as indigenous territories. And new conservation areas are strategically planned. For example, Juruena National Park (declared in June 2006), twice the size of the U.S. Yellowstone National Park, is one of the last missing pieces in the southern Amazon conservation corridor, forming a virtual green barrier that will help control land degradation and agricultural expansion in a region that has suffered some of the highest rates of illegal logging and deforestation in recent years (Map 5 on the inside back cover). In addition to protecting areas further north, the corridor itself has considerable biodiversity value.

6.6.4 Ensuring Law Enforcement for Land and Resource Use

While incentives may be used to encourage migrants to settle in areas where there will be least harm to biodiversity and local residents and where they will be able to gain a livelihood, law enforcement is often needed to discourage them from settling in other areas, such as protected areas and indigenous reserves. This is important not only from a pure conservation standpoint, but also to ensure long-term livelihood sustainability for residents. Law enforcement should follow national legislation and should be done in a way that respects human rights.

Law enforcement may be done by protected area authorities, local government authorities or trained community members who have official law enforcement status. Police or military force in destination areas is sometimes used in extreme cases, but this type of strong intervention, albeit at times effective in the short term, does not guarantee lasting results. When migrants moved into the national forests of the Nepalese Terai, for example, enforcement bodies razed, bulldozed and burned their settlements, but this did not provide sufficient deterrence and some have returned (Chungyalpa, pers. comm. 2006). In another case, the national army and helicopters were dispatched to disperse gold miners in the Phuoc Son area of Vietnam's Lower Mekong River valley, but the miners learned of the plan ahead of time, left before the squadrons arrived and returned to the site later. Gold miners continue to operate throughout Quang Nam and Song Thanh (Hardcastle, pers. comm. 2004).

A show of force will be more effective in the long term if legal grounds exist for its use and if it is seen as socially legitimate. This is crucial if any local population lives inside or next to a protected area. If resident communities are receiving benefits from the protected area, and ideally have some say in its management, they are much more likely to recognize the legitimacy of the protected area. Keeping local communities and migrants informed is important, yet particularly challenging in remote locations that have little access to public sources of information. In many cases, migrants arriving from other regions, and sometimes even local residents, are unaware of the existence of protected areas or the location of their boundaries.

In the Maya Biosphere Reserve there has been confusion for years regarding the existence of national parks and the land- and resource-use restrictions that apply to both reserve lands and national park lands (Margoluis 2004). In

Box 9. Mining Agreements With Communities in CAR

In the Dzanga-Sangha Reserve in Central African Republic, an agreement was negotiated between the reserve and the surrounding mining communities, identifying areas that could be mined and those that could not. Now prospective diamond miners are warned when prospecting in restricted areas. If miners do not abide by the warnings, their supplies and prospecting materials can be confiscated and shanties located in restricted areas burned (Blom, pers. comm. 2004). The park employs a substantial number of park guards who undergo intensive training for this work. The clear set of rules and their enforcement have led to a substantial decrease in tension between the mining community and the reserve.

CREDIT: © WWF / Zig Koch

The Augusto Falls on the Juruena River, Juruena National Park, Brazil

addition to some form of law enforcement such as park guards, good communication is important for long-term intervention strategy. An effective communication program that informs people about the boundaries of a protected area and restrictions that apply regarding its use can also assist in improving relations between field-based conservation staff and local residents.

6.6.5 Encouraging Voluntary Resettlement

Relocation strategies have been tried with varying degrees of success in many countries. Again, it is important to observe national legislation and protect human rights. Various resettlement guidelines exist; for example, the World Bank (2004) has guidelines for involuntary resettlement that have specific provisions for protected areas. In the guidelines, communities should be no worse off than they were before they were resettled, and ideally should be better off. Resettlement is often extremely expensive; any project that proposes resettlement should budget adequate funds for it. Costs of resettlement include provision for land titling, social services, physical infrastructure and establishment of livelihood activities. The costs of resettling migrants are likely to be higher than the costs of retaining people in the area of origin in the first place.

In the Maya Biosphere Reserve in Guatemala, attempts to relocate families from the reserve's core zone to areas with better access to social services were orchestrated by The Nature Conservancy (TNC) in partnership with the Guatemalan government. One of the major incentives in the program was assistance for migrants with the land-titling process, which is often long, confusing and frustrating in Guatemala. Settlers were also provided with a long-term, low-interest loan to help cover expenses, and technical assistance to help them adapt to the new area. Though the program is somewhat controversial, in general those who obtained land titles were more positive about having the reserve as a protected area than those without land titles (Margoluis 2004).

Providing more accurate information about the restrictions on settlement and resource use in and around protected areas may be sufficient incentive for migrants to stay where they are—or to accept being settled in less biologically important, but economically preferable areas. Evidence from surveys in the Maya Biosphere Reserve shows that migrants tend to judge a location's suitability by its proximity to water, road access to the community, and soil fertility (Margoluis 2004).

Eligibility for other types of benefits can also make a new location more attractive. As part of the management plan for the Waza National Park in Cameroon, a collaborative management committee was established. Committee membership was offered to park management staff and villages situated on the park boundary or with territories bordering it. It was not offered to those living inside the

protected area. As part of the Integrated Conservation and Development Project (ICDP) approach sponsored in part by the World Conservation Union (IUCN), project benefits were linked to representation on the management committee, so that only members of villages located outside the park were eligible to receive benefits, such as access to water pumps. Interest in receiving project benefits proved a sufficient incentive to prompt the voluntary relocation of a number of families living inside the park to villages outside the park (Scholte 2003).

6.6.6 Strengthening Land and Resource Tenure

Strengthening local tenure is a common way to limit or prevent in-migration. When local communities have secure, formally recognized control over land and resources, they are often able to prevent unwanted migrants from moving in. This approach is planned, for example, in parts of the East African Marine Ecoregion in Tanzania, Mozambique and Kenya to protect local fishing rights and prevent migrant fishermen from depleting resources (Goeltenboth, pers. comm. 2006). In Nepal, when management of a government forest is handed over to community forest user groups, local communities control use of the forest and the benefits from it. This fosters such a strong sense of responsibility for guardianship of the forest that the local communities prevent migrants from settling in the area (Manandhar, pers. comm. 2006).

An approach that grew out of the experience with resettlement in the Maya Biosphere Reserve is the use of "agreements of permanence." CI facilitated these agreements as an alternative to resettlement to ensure user rights, but not title, for families that preferred not to relocate. Agreements were provided for a specific number of families per community and required that no additional settlers live on the land. These agreements have been difficult to enforce, however, which has greatly reduced their efficacy.

6.6.7 Limiting Plot Size and Intensifying Agriculture

Some countries have allocated larger plots of land to settlers than necessary (e.g., 200 hectares initially in Rondonia, Brazil), failing to anticipate the high future demand. This has often tied the hands of policymakers in later creating protected areas. Subsequent settlers then receive smaller plots than the early settlers, or none at all, perhaps being relegated to buying a small part of an existing plot from an earlier settler, as happened in the Ecuadorian Amazon (Bilsborrow *et al.* 2004). Moreover, larger plots are commonly "secured" through forest clearing and wasteful, extensive forms of land use such as cattle grazing, as opposed to intensive production systems.

Intensifying production on settled land can increase the number of people it supports, thereby encouraging people to stay rather than moving on yet again to expand the frontier. More intensive and diversified production systems such as agroforestry, irrigated agriculture, small livestock and home gardens can greatly improve productivity. Agroforestry systems offer added benefits of conserving soils, improving fertility and maintaining forest cover. Intensification in destination areas, as in origin areas, can also be stimulated by more technical assistance combined with credit, but with both limited to small farmers (Bilsborrow *et al.* 2004).

6.6.8 Developing Alternative Livelihood Opportunities

To improve livelihoods and take pressure off land and natural resources, alternative livelihoods that do not require unsustainable use of natural resources or cause loss of habitat through land clearing may be developed. Possibili-

CREDIT: © WWF / Judy Ogilethorpe

Tying seaweed on strings where it will grow in shallow water before being harvested

ties include the development of small-scale enterprises and alternative employment opportunities. One example of a successful small-scale enterprise is seaweed farming in the Philippines. Population pressure and overuse of marine resources have resulted in migration from the Visayas to Palawan, which is seen as one of the last places in the Philippines with remaining space and resources. Many migrants have settled in the area of Roxas, including Green Island. Migrants have placed unsustainable fishing pressure on the marine resources. The introduction of seaweed farming, an activity with very few environmental impacts that can provide income for up to 9 months of the year, has provided alternative incomes for migrants and local residents alike (Albasin, pers. comm. 2006).

Development of ecotourism can provide alternative livelihoods, with strong incentives for communities to care for biodiversity. Benefits to communities vary greatly, depending on tourism potential, markets and the way benefits flow (ranging from community-run tourism and joint ventures with the private sector to simple provision of employment by private operators). As an example of the latter, many indigenous people in the Amazon Basin are employed as guides, cooks or canoe motorists. Protected areas are also often one of the main employers in remote areas. For example, a number of men from the Cofan community of Zabalo, on the Aguarico River in the northeastern Ecuadorian Amazon, have recently been trained as park guards to protect the Cuyabeno Wildlife Reserve.

Infrastructure development and extractive industries such as mining, oil, gas and logging can provide employment. However, these activities are often temporary and can create more social and environmental problems than they solve. For example, many Huaorani men in Ecuador

CREDIT: © WWF / Judy Oglethorpe

Harvested seaweed drying in the sun in the Philippines before it is sold to lucrative regional markets

CREDIT: © CI / Haroldo Castro

Ecotourism in Madidi National Park, Bolivia

engage in short-term, temporary work with oil companies, but with generally negative environmental implications for the region and the Huaorani communities themselves.

In the Galapagos, one approach to reduce pressure of migrants has been to develop alternative livelihoods for fisher families and to add value to legal fishing activities. For example, a group of fishermen's wives is adding value to tuna by smoking it for sale to tourists. Plans exist for four fishing cooperatives to take tourists out on fishing boats to observe the fishing, generating higher revenues for the fishermen (Spurrier, pers. comm. 2006).

6.6.9 Setting Quotas and Promoting Lower-Impact Extraction Methods

Quotas can be an effective mechanism for controlling the impact of certain natural resource-based activities by migrants, if enforcement is adequate. For example, in the Galapagos, where economic opportunities through tourism attract migrants from the mainland, quotas were set through the special law to limit the number of tourist boats. However, the recommended tourist limits have not been followed and tourism has continued to increase; visits now far surpass the 1998 levels (Bremner, pers. comm. 2006). Land-based tourism is also becoming more popular, so the boat-quota mechanism is less effective. In addition, the labor laws have not been enforced, and people come from the mainland for employment, attracted by higher salaries. Tourism labor practices need to be linked to the tourism license renewal process to improve enforcement.

In the Guianas (Guyana, Suriname and French Guiana), migratory artisanal gold miners cause significant damage to freshwater systems by using mercury to extract gold from mines, and by dumping tailings (mine waste) directly into rivers and creeks in the Guianan Moist Forest. WWF

CREDIT: © WWF / Cara Honzak

Family planning and HIV/AIDS awareness and prevention are provided to local communities and migrants in Kiunga, Kenya.

is working with artisanal and small-scale miners, regulatory institutions, universities and other relevant stakeholders to promote the use of alternative, less damaging practices to extract gold. The environmental issues surrounding gold mining are common throughout the three Guianas. A harmonized approach across the three countries is therefore required to address them, since strengthening only one country to deal with the problem merely shifts the damage to the other countries: The miners move to where the regulatory capabilities are weakest (Hays & Vieira undated).

6.6.10 Improving Access to Family Planning

After settlers arrive in areas of high biodiversity, they usually have high fertility rates for several years. This is due primarily to resource access, the low costs of raising children, the economic value of children for labor and the lack of health and family planning infrastructure. The result is rapid population growth in these areas, even in the absence of further in-migration. The children of the original settlers then grow up to have their own families, often clearing additional forests for the creation of new farms.

Improving access to health and family planning services responds to the high unmet need for family planning in these areas—women are having more births than they desire. This has been confirmed in the Ecuadorian Amazon for both migrant (Bilsborrow *et al.* 2004) and indigenous populations (Bremner & Bilsborrow 2004). In most countries, frontier areas have been neglected by both government agencies and private sector NGOs even as they expand reproductive health services elsewhere in the country. In the Roxas area of Palawan, Philippines, WWF works with the Local Government Unit, with technical assistance from Save the Children, on an integrated population-health-environment program. The program aims to improve reproductive health/family planning for migrants and longer-term residents through increased awareness of and access to family planning services and commodities.

HIV/AIDS awareness and prevention can be undertaken through the same health services as family planning. This is a potentially important method of decreasing the spread of HIV through migrants who come from areas of high HIV prevalence. Oglethorpe and Gelman (2004) give details on ways the conservation sector can work with the health sector and others to reduce environmental and livelihood impacts of AIDS.

6.6.11 Providing Social Services

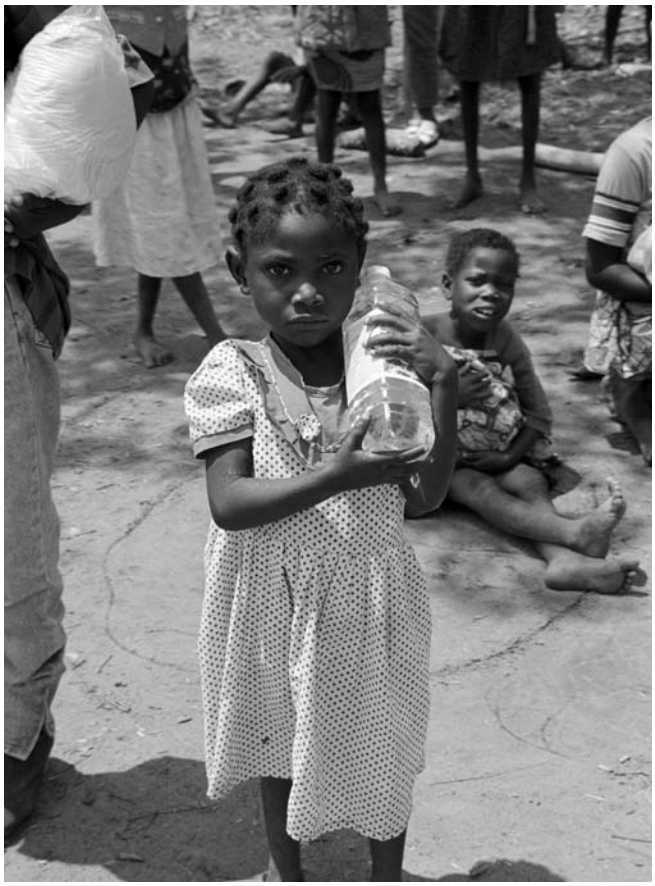
Improved provision of social services, such as schools and health clinics, can raise the level of education among settlers and improve health. As well as improving quality of life, this can enable them to manage land and resources more effectively and increase their capacity for nonagricultural employment. Alternative livelihoods may reduce their focus on agriculture and resource extraction. However, improved social services may stimulate even more in-migration. Thus, intervention strategies to reduce impacts of migration that include provision of social services should also ensure tenure security and enforcement.

6.7 Interventions for Armed Conflict and Natural Disasters

Armed conflict and natural disasters can result in large-scale and sometimes sudden movements of people. Often there is little prior warning or time for specific preparedness planning. Some key actions to reduce impacts of conflict and disaster migration are outlined below; more detail is given in Shambaugh *et al.* (2001) for armed conflict situations. Partnerships across many sectors, particularly humanitarian assistance and development, are a key factor in reducing impacts of migration from conflict and disasters. The conservation sector can also play a major role by providing timely inputs to help improve planning and practices of relief and reconstruction initiatives to reduce environmental impacts. This includes training to build environmental capacity in these sectors.

6.7.1 Supporting Local Community Livelihoods

In conflict and disaster situations, people migrate when it is unsafe for them to stay, or when their livelihoods and well-being are severely threatened. Sometimes insecurity or natural disaster results in breakdown of economies and loss



CREDIT: © WWF-Canon / Jo Benn

Provision of culturally acceptable food supplies in refugee and IDP camps helps prevent hunting and collection of wild foods.

of agricultural productivity, but people remain in the area because it has not yet become too unsafe. In this case, they often increase their use of natural resources as a safety net, sometimes with severe environmental impacts. In conflict situations conservation organizations have often shifted to focus on community livelihoods, such as promotion of more sustainable resource harvesting, to try to limit damage to biodiversity. By supporting community livelihoods and helping to limit damage, migration may be prevented.

6.7.2 Reducing Impacts of Refugees and Internally Displaced Persons

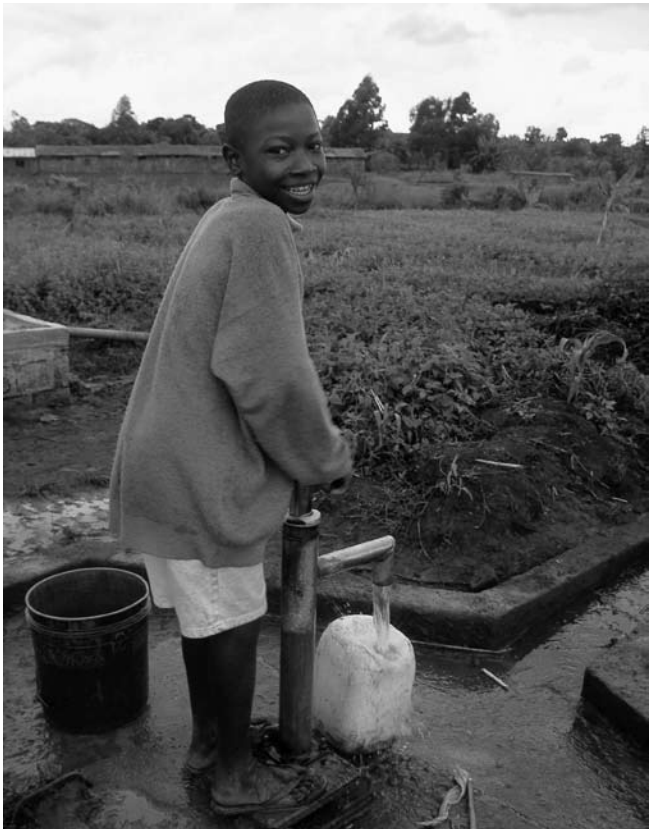
Experience has shown that by maintaining a presence in protected areas during times of conflict, government departments and NGOs can greatly reduce damage to the environment. In the Okapi Reserve, the presence of a dedicated and well-trained national staff during conflict was able to prevent the death of captive wildlife populations such as the okapi, and prevent illegal miners from taking advantage of the chaos brought about by the civil unrest (Hart & Hart 2003). Having a good history of conservation support before the conflict was also important. Reflecting on the effects of this later, wildlife biologists John and Terese Hart (2003, p. 17) wrote, "The individuals who took the greatest risks [in support of conservation during the war] had a clear sense of their professional mandate and had confidence that they would continue to receive outside support to fulfill that mandate." In addition, troops showed greater respect for populations of closely monitored wildlife (okapi in this case, and habituated gorilla families in nearby Kahuzi-Biega National Park) than for wildlife in general. Thus international investment in and support for conservation prior to and during the war probably helped reduce the impacts.

There is some evidence that provided the scale of displacement is not too great, there is less environmental impact when newcomers are integrated into local communities rather than settled into separate camps (Jacobson 1994). This is contingent upon the integration of both locals and incomers into joint resource management programs. In some cases the incomers may even bring in new approaches that improve resource use in the destination area. Conservation organizations that are already working with local communities can support them in negotiations and dialogue over refugee and IDP arrangements to reduce impacts on long-term local livelihoods.

However, very often the scale of migration or the political situation makes separate refugee or IDP camps necessary. Host countries often site refugee camps in remote, undeveloped and marginal areas, which can have valuable but vulnerable biodiversity. Refugee camp planning is often politically sensitive, but it may be possible for conservation organizations to collaborate on site selection to reduce impacts. This is more feasible in slow-onset situations and

CREDIT: © UNHCR / L.Taylor

Internally displaced Sierra Leoneans and refugees from Guinea receive training in Grafton, Freetown.



CREDIT: © UNHCR / L.Taylor

In Tanzania's Mtabila camp, a clean water source is essential to prevent the spread of diseases like dysentery and infectious hepatitis.

involves developing working relationships with governments and international relief organizations such as the UNHCR beforehand. It also requires good biodiversity information, including maps showing the distribution of important species and vegetation types, ecological processes such as animal movement routes and key water catchments, protected area locations, and natural resources and their use by local residents. A database of local biodiversity experts is also very useful.

6.7.3 Promoting Sound Environmental Practices in Refugee and IDP Camps

At time of crisis, saving human life is paramount, and it is often difficult to think of the environment. However, humanitarian assistance organizations are increasingly realizing the importance of good environmental practices in camps, since it is cheaper to prevent or mitigate environmental damage than repair it afterwards. In addition, better environmental practices result in less friction with host governments and fewer impacts on resident communities and their long-term livelihoods. Some organizations have guidelines to reduce environmental impacts of camps. UNHCR's guidelines for the emergency phase and the care-and-maintenance phase that follows cover procurement, physical planning of sites, water and sanitation, health, food, energy, forestry, agriculture/livestock, community services, education and income generation When refugees vacate camps the areas should be rehabilitated: this includes waste cleanup and disposal, and site and ecosystem rehabilitation (UNHCR 2005).

In 1994, about 720,000 Rwandan refugees moved into the Virunga National Park in DRC and remained there for 2 years. To mitigate rapid deforestation, UNHCR cooperated with implementing agencies to distribute wood to camps from tree plantations. This was effective in places where there was adequate security and where fuel-efficient stoves and improved cooking practices had been introduced (Shambaugh *et al.* 2001).

Family planning is an important service to provide to refugees and IDPs, who tend to have poorer access to these services than resident communities. Awareness and prevention of sexually transmitted diseases, including HIV/AIDS, is also crucial: Refugees will eventually return home, and it is important to prevent transmission of HIV, particularly to previously uninfected or low-prevalence areas. Environmental consequences of both unmet need for family planning and AIDS have been covered in previous sections.

Another way to promote sound environmental practices in refugee camps is to provide relief organizations with environmental training. Conservation organizations can partner with relief organizations to fill this role. For example, the International Gorilla Conservation Programme has provided UNHCR in East Africa with environmental technical assistance and training in the establishment, operation and rehabilitation of camps. A major challenge that relief organizations face is high turnover in staff in the field, which necessitates continuous training of new staff in environmental aspects.

CREDIT: © USAID / OFDA

Thatching hut for IDPs, Liberia

CREDIT: © CI / Daniel Juhn

Residents rebuilding after the 2004 tsunami, Banda Aceh, Indonesia

6.7.4 Encouraging Sound Resettlement After Conflict or Disaster

Returning refugees and IDPs are faced with the huge challenge of restoring their homes, livelihoods, and social and economic structures. In the first year, they are often very reliant on natural resources. Providing emergency food and building materials helps to reduce some of this pressure. Relief organizations often provide emergency food for the first year after people return. WWF is working with policymakers and agencies involved in Indonesian reconstruction after the 2004 tsunami to use sustainably harvested timber from outside the country, to reduce pressure on Indonesia's already-stressed forests.

If unsustainable resource use was occurring before the natural disaster or conflict, the disruption to settlement and livelihoods may be an opportunity to review previous practices and set livelihoods on a more sustainable footing after people return. This is a time when people are often receptive to new ideas and change, having had a forcible break with the past, and they may be willing to create alternative sources of livelihoods and adopt new ways of using resources.

During resettlement there may be a risk of people opportunistically moving into protected areas for the first time. If protected area managers are on site at the time, they should be vigilant for this and try to find appropriate solutions with the people concerned and the local authorities. It is best to act immediately: Once settlements become established with infrastructure, social services and economic activity, the move may be much more difficult to reverse.

6.7.5 Integrating Demobilized Soldiers into Society

When armies are demobilized, soldiers may return to their areas of origin. But if the conflict has been prolonged with serious social upheaval, they may no longer feel that they belong or have a future there. Instead they may settle in other areas, where they can have serious impacts on natural resources. For example, in Mozambique many demobilized soldiers in the early 1990s settled along main roads and made charcoal; others started fishing commercially (Hatton *et al.* 2001). Local communities were powerless to prevent damage to their natural resource base and sacred forest when faced by groups of trained combatants. The conservation sector can play its part in helping to integrate demobilized soldiers into society. In Mozambique some demobilized soldiers were successfully employed in protected areas as game guards. They had excellent qualifications: ability to live in the bush, good tracking skills and familiarity with firearms.

CREDIT: © L. Rose / USAID

Demobilized ex-combatants re-establishing their lives and livelihoods in Butembo, Democratic Republic of Congo

6.7.6 Participating in Postwar Policy Development and Reconstruction

The period after conflict is often a window of opportunity to update old national policies. New policies can be introduced that promote long-term livelihoods of rural communities that use natural resources and steward biodiversity, for example, through improving access and tenure to land and resources. In turn, the promotion of long-term livelihoods contributes to lasting peace and reduces the likelihood of further conflict-induced migra-

CREDIT: © WWF-Canon / Jeff Foott

Rhino in Chitwan National Park, Terai, Nepal: rhino poaching increased during the conflict and has continued into the early peace stage.

tion. Both Uganda and Mozambique undertook this type of policy reform once peace returned. Conservation NGOs can support policy development by providing information, building capacity and providing funding.

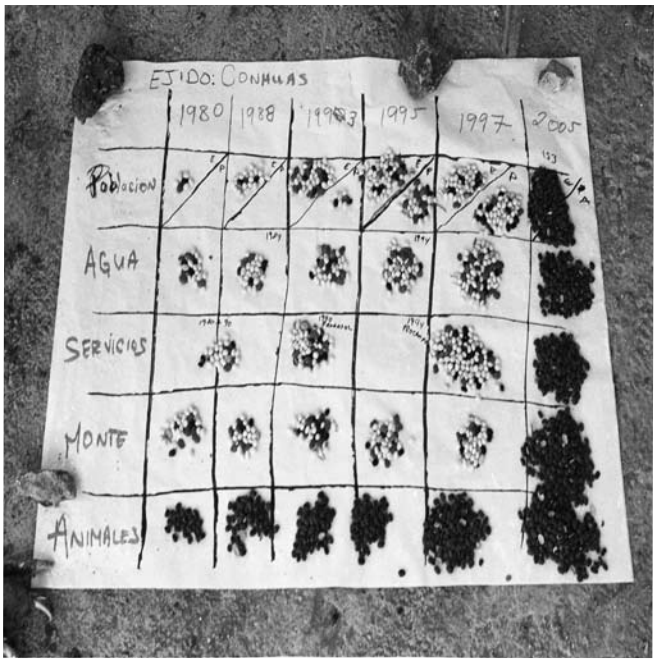
At the same time, with the coming of peace there is often a big push to rebuild the economy and open up new development such as new infrastructure and expansion of agriculture and extractive industries, including logging. For example, oil palm and soybean development is being proposed in Banda Aceh, Indonesia, with the coming of peace (van Breda, pers. comm. 2005). Since governance tends to be weak after conflict, illegal resource extraction is common, as happened in Mozambique after the last war (Hatton *et al.* 2001). These developments can involve further movement of people seeking employment, at a time when government planners are often not in a position to anticipate or control likely environmental impacts. Conservation practitioners in government departments and NGOs can play a very important role in cross-sectoral planning and offer support at this stage to reduce impacts.

Wetland in the Terai, Nepal: in 2006 after the conflict, conservation organizations were working to incorporate environment and sustainable natural resource management into the new national Constitution.

THE IMPORTANCE OF MONITORING

It is important to monitor existing and potential threats to biodiversity, including migration. Monitoring necessitates a sound understanding of political, economic, social, cultural, environmental, institutional and policy issues at different scales, grounded where possible in an analysis of potential impacts on biodiversity. In many situations, this should give early warning of potentially harmful migration. In the past it has often been difficult for conservationists working at a local level to be aware of consequences from global-level threats, such as world trade patterns or climate change. However, the advent of the Internet and improved networking makes it much easier to tap into specialist networks and increase awareness of threats at different levels on a timely basis.

Monitoring also involves collecting data at a more local level—information on the resident population, such as population size, resource use, household size, fertility, standards of living, origins of migrants and reasons for migration. This type of information is often not known to conservationists when developing interventions, yet it can be particularly important when changing land-use zones, such as the creation of protected areas. Without these basic demographic and related data, conservation organizations run the risk of developing problematic interventions—such as the creation of national parks where communities already reside. A population monitoring system developed for the Calakmul Biosphere Reserve in the Yucatan peninsula is a good example of how this information can provide a useful framework (Bilsborrow *et al.* 1998). It proposes regular but inexpensive, quick, surveys of inhabitants of communities in and around the reserve, as well as interviews with community leaders and informants (see Box 10). Monitoring systems have also been considered in the Dzanga-Sangha case and are currently being used to collect census data in Okapi Faunal Reserve (Tshombe, pers. comm. 2005).



CREDIT: © WWF / Jenny Ericson

Matrix of population and natural resource trends for the ejido 11 de Mayo located on the southern border of Calakmul Biosphere Reserve, Mexico

Considerable demographic and social information is often available from government agencies (including census and statistical offices) and from national and international NGOs. Many countries have carried out national Demographic and Health Surveys that contain a wealth of information on national samples of 5,000 to 20,000 households and women. However, these surveys rarely cover the small and inaccessible populations living in remote frontier areas where protected areas tend to exist.

Box 10. Population Monitoring System Example

To improve understanding of population-environment dynamics, a population monitoring system was proposed for the rapidly changing frontier zone around the Calakmul Biosphere Reserve in the state of Campeche, Mexico. The proposed system called for the integration of data currently collected every 5 to 10 years by government agencies, with data collected biannually by a specialized consultant, and data collected every 12 months by local community leaders. The data collected by the consultant would result in a population profile of the Calakmul region, based on interviews with key informants and available sources of quantitative and qualitative information on settlements, including location, population size and growth, migration tendencies in and out, and changing patterns in land use. The data collected by local community leaders (with initial guidance from the consultant) would come from a randomly selected group of *ejido* communities in the region and be both quantitative and qualitative. It would include demographic data (population in community, ethnicity, households, approximate ages, places of origin of in-migrants and of destination of out-migrants, dates of arrival and departure, etc.), data on land use and commercialization of products, and qualitative data collected through participatory techniques designed to capture a collective viewpoint and identify patterns.

Integration and organization of the data collected would require collaboration between all interested groups and be facilitated by institutions with regional authority and influence, such as the Calakmul municipal government, the Calakmul Biosphere Reserve, and an active and interested local NGO (Bilsborrow *et al.* 1998, Ericson & Freudenberger 1998).

Therefore, population monitoring usually calls for the establishment of a new data collection mechanism, such as rapid surveys or participatory population monitoring systems (Bilsborrow *et al.* 1998, Ericson & Freudenberger 1998). And situations can change rapidly, for example, due to natural disasters, sudden escalation of armed conflict, introduction of a new policy, opening of a new road or discovery of a new mineral deposit. Therefore, it is important to update the conceptual framework on threats to biodiversity, root causes, existing and potential push and pull factors, and opportunities to intervene. Demographic data constitute a fundamental part of this framework.

CREDIT: ©WWF / Jenny Ericson

Mapping land use through participatory techniques with members of the ejido Nueva Vida on the outskirts of Calakmul Biosphere Reserve, Mexico

THE WAY FORWARD: RECOMMENDATIONS

In previous sections we have discussed migration impacts on biodiversity and interventions that have been proposed or implemented to reduce adverse effects. We stressed the importance of gaining a deep and holistic understanding of the situation, developing a vision for conservation that incorporates sustainable development for local residents and migrants and selecting the most appropriate interventions on this basis. It is too early to draw conclusions about the most effective interventions because there are few documented examples and little monitoring of outcomes.

The conservation sector still has much to learn about migration, its impacts, and the types and effectiveness of interventions. The follow-up actions below are proposed to enhance our understanding and develop more effective approaches:

Increase awareness of the impacts of migration on biodiversity through improved documentation and dissemination of in-depth case studies. The case studies presented in this review are a small sample, were undertaken as a desk exercise and in many cases have not been developed in depth. Deeper analyses of migration situations and the effectiveness of interventions are needed to enhance our understanding of migration and its impacts on areas of high biodiversity. Collecting baseline data is crucial for these analyses.

Conduct pilot studies of promising new approaches to migration. Such studies are needed to expand the "toolbox" of interventions, with careful monitoring to measure effectiveness of approaches at different levels and on different timescales. This includes examining the effectiveness of partnerships across organizations and sectors. Sites where interventions are already taking place can be used to monitor the impacts and progress of ongoing interventions. Sites where interventions have not yet been tried can be used as pilot sites for testing promising new approaches.

Conduct further review of likely impacts of global trends. Section 4 outlined likely impacts from several global trends, such as population growth due to fertility, consumption of resources, climate change, globalization of trade, increased conflicts and emerging diseases. However, this section was necessarily vague because some of these trends (such as climate change) are at an early stage, and there are often no linked demographic and environmental data to test and substantiate impacts. Further work is needed to predict the likely impacts by scale and location, to track them if and when they occur and to promote measures to reduce negative impacts.

Similarly, more work is needed on the impacts of international capital investment flows on migration in areas of high biodiversity, such as investment in tourism, mining and local infrastructure. One example is the impact of increasing Chinese investments in extractive industries in many parts of the world. Studies are currently being carried out on such international investment flows (e.g., by the World Bank); results should be used to help gauge the impacts of such investments in the future on migration flows and biodiversity.

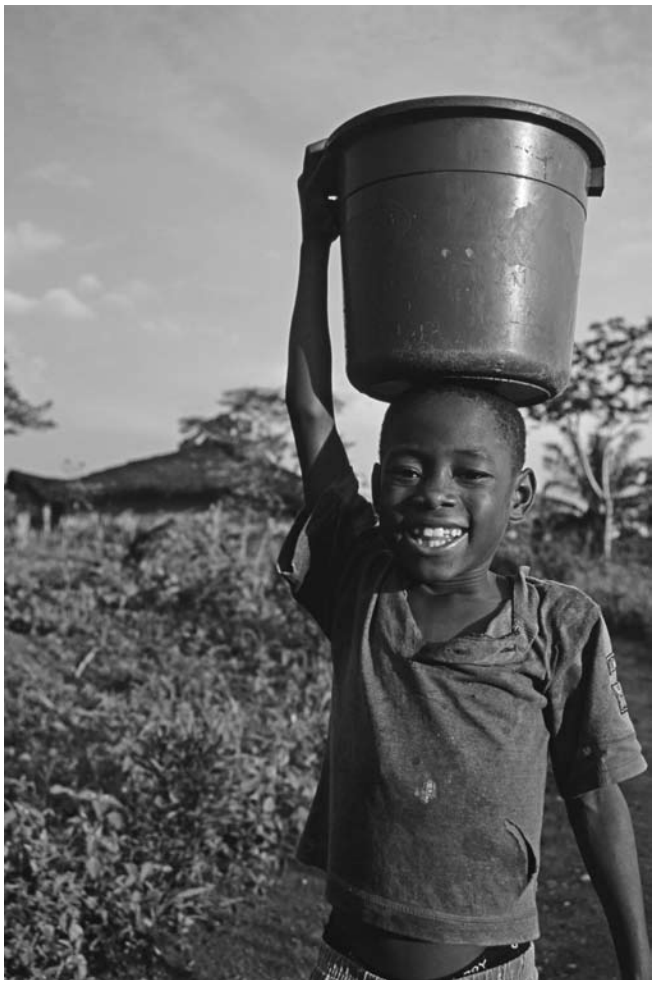
Develop diagnostic tools. Conservation organizations and agencies often lack sufficient local staff, training and skills to work effectively with rural migrant communities and to help them confront the challenges they pose in areas of high biodiversity. In addition, in the course of preparing this review, it has become clear that most cases of migra-

tion are not well documented: Even the basic numbers of people involved are often unknown, not to mention their impacts on biodiversity. Where do conservation practitioners turn when they need assistance in identifying where migration is a problem or measuring it and its impacts? Where can they turn when searching for interventions that can address both the needs of people (including migrants) and the desirability of protecting biodiversity? It would be very useful to develop guidelines, possibly in the form of diagnostic tools to analyze migration situations and then to guide practitioners to measure, predict and mitigate the impacts of human migration movements on areas of special conservation interest. Guidelines might include a decision tree to flag different types of interventions and combinations or sequences of interventions that would be appropriate in different situations. This publication aims to serve as a step toward that goal.

Conduct a global review of migration threats to biodiversity, by region. This proposal was beyond the scope of the current study. However, it would be very useful to map current and future threats to biodiversity from likely future migration flows by country and region, taking into account global and regional trends in international markets, infrastructure development, government policies and climate change. This could be linked to biodiversity prioritization (e.g., hotspots, priority ecoregions) to predict where migration is most likely to cause significant conservation problems on a subnational level. Similar exercises could then be aggregated up to the national level and to regional levels around the world.

Conduct periodic reviews of progress on migration. Given the growing interest of the conservation community in migration, a series of workshops could be organized for conservation organizations and other sectors to study and discuss how migration and conservation are linked, exchange experiences and knowledge, draw lessons and point toward the development of useful tool kits. Even in the short run, such workshops will build capacity to tackle migration issues.

Increase funding for research in this area. Migration has had considerable difficulty attracting funds, unlike, for example, fertility and mortality/health research. Migration is inherently multidisciplinary and involves multiple locations, productive sectors and populations; donors prefer to fund activities that are more straightforward and clearly fall within a specific sector or location. But in the face of the increasing complexity and interconnectedness from local to global scales, there is a great opportunity here to explore an emerging, complex subject that links conservation to other sectors.



CREDIT: ©CI / John Martin

Boy from local community carrying water, Liberia

We hope that this exploratory publication is useful to readers, and that it catalyzes further work in this field. Much more work is needed to improve our understanding of human migration and environment linkages, and to develop new tools and approaches for conservation practitioners in the future. We look forward to collaborating with many different projects and partners in this quest, and wish readers success in reducing the adverse impacts of migration on biodiversity and on the local communities who steward it.

REFERENCES

Albasin, S. 2006. Personal Communication. Project manager, Roxas, WWF Philippines. March 10.

Alger, K. 2003. The reproduction of the cocoa industry and biodiversity in southern Bahia, Brazil. Smithsonian Migratory Bird Center. Smithsonian National Zoological Park. Online. Available: http://nationalzoo.si.edu. October 10, 2006.

Alger, K. 2005. Personal Communication. Vice president of Human Dimensions Program, Conservation International. May 27.

Avissar, R. & Werth, D. 2005. Global hydroclimatological teleconnections resulting from tropical deforestation. *J. Hydrometerology* 6: 134–145.

Barreto, P., Souza, C., Nogueron, R., Anderson, A. & Salomao, R. 2006. *Human Pressure on the Brazilian Amazon Forests.* Washington, DC: World Resources Institute.

(BBC) British Broadcasting Corporation. 2006. Migration glossary. Online. Available: http://news.bbc.co.uk/1/hi/in_depth/3527123.stm). July 15, 2006.

Beckman, S. & Rai, P. 2005. *Mozambique, HIV/AIDS, Work and Development.* Geneva, Switzerland: ILOAIDS, International Labour Organization.

Begossi, A. 1998. Resilience and neo-traditional populations: The caicaras (Atlantic Forest) and caboclos (Amazon, Brazil). In F. Berkes & C. Folke (Eds.), *Linking Social and Ecological Systems: Management Practices and Social Mechanisms for Building Resilience.* pp. 129–157. Cambridge, UK: Cambridge University Press.

Bilsborrow, R.E. 1987. Population pressures and agricultural development in developing countries: A conceptual framework and recent evidence. *World Development* 15(2): 183–203.

Bilsborrow, R.E. 1992. *Rural Poverty, Migration and the Environment in Developing Countries: Three Case Studies.* World Bank Policy Research Working Paper (WPS 1017). Background paper for the World Bank, *World Development Report, 1992: Development and the Environment.* Washington, DC: The World Bank.

Bilsborrow, R.E. (Ed.) 1998. *Migration, Urbanization and Development: New Directions and Issues.* Norfolk, NH, and New York, NY: Kluwer Academic Publishers and United Nations Population Fund.

Bilsborrow, R.E. 2002. Migration, population change, and the rural environment. *Environmental Change and Security Project Report,* no. 8: 65–94. Washington, DC: Woodrow Wilson Center.

Bilsborrow, R.E. & Carr, D. 2001. Population, agricultural land use and the environment in developing countries. In D. Lee and C. Barrett (Eds.), *Tradeoffs or Synergies? Agricultural Intensification, Economic Development and the Environment.* pp. 35–55. Wallingford, UK: CAB International.

Bilsborrow, R.E. & DeLargy, P. 1991. Land use, migration and natural resource deterioration: The experience of Guatemala and the Sudan. *Population Development Review* 16 (Supp.): 125–147.

Bilsborrow, R.E. & Geores, M. 1994. Population change and agricultural intensification in developing countries. In L. Arizpe, D. Major & P. Stone (Eds.), *Population and the Environment: Rethinking the Debate.* pp. 171–207. Washington, DC: Westview Press, for Social Science Research Council.

Bilsborrow, R.E. & Okoth-Ogendo, H. 1992. Population-driven changes in land use. *Ambio* 21(1): 37–45.

Bilsborrow, R.E. & Stupp, P. 1997. Population dynamics, land use change and deforestation in Guatemala. In A. Pebley & L.R. Bixby (Eds.), *Population and Development in the Isthmus of Central America.* pp. 581–623. Santa Barbara, CA: Rand Corporation.

Bilsborrow, R.E., Oberai, A.S. & Standing, G. 1984. *Migration Surveys in Low-Income Countries: Guidelines for Survey and Questionnaire Design.* London, UK, and Sydney, Australia: Croom Helm, for the International Labour Office.

Bilsborrow, R.E., McDevitt, T., Kossoudji, S. & Fuller, R. 1987. The impact of origin community characteristics on rural-urban out-migration in a developing country. *Demography* (24): 191-210.

Bilsborrow, R.E., Hugo, G., Oberai, A.S. & Zlotnik, H. 1997. *International Migration Statistics: Guidelines for Improving Data Collection Systems.* Geneva, Switzerland: International Labour Office.

Bilsborrow, R.E., Ericson, J. & Rodriguez, R.M. 1998. *Sistema de monitoreo de poblacion para la Reserva de la Biosfera de Calakmul—Una Propuesta.* Merida and Mexico, DF, Mexico: Pronatura de Yucatan and World Wildlife Fund.

Bilsborrow, R.E., Barbieri, A. & Pan, W.K. 2004. Changes in population and land use over time in the Ecuadorian Amazon. *Acta Amazonica* 34(4): 635–647.

Black, R. 2001. Environmental Refugees: Myth or Reality? *New Issues in Refugee Research.* Working Paper No. 34, for the United Nations High Commission on Refugees. Brighton, UK: University of Sussex.

Blom, A. 2004. Personal Communication. Deputy director, Congo Basin, World Wildlife Fund-US. June 14.

Borrini-Reyerabend, G. (Ed.) 1997. *Beyond Fences: Seeking Social Sustainability in Conservation.* Gland, Switzerland: International Union for the Conservation of Nature and Natural Resources (IUCN).

Boserup, E. 1965. *Population and Technological Change: A Study of Long-Term Trends.* Chicago: University of Chicago Press.

Brandon, K., Gorenflo, L.J., Rodrigues, A.S.L. & Waller, R.W. 2004. Reconciling biodiversity conservation, people, protected areas and agricultural sustainability in Mexico. *World Development* 33(9): 1403-1418.

Bremner, J. 2006. Personal Communication. University of North Carolina Ph.D. candidate. August 26.

Bremner, J. & Bilsborrow, R.E. 2004. *Indigenous Populations and Fertility in the Ecuadorian Amazon.* American Public Health Association Annual Meeting. November 6–10, Washington, DC.

Bremner, J. & Perez, J. 2002. A case study of human migration and the sea cucumber crisis in the Galapagos Islands. *Ambio* 31(4): 306–310.

Browder, J. 1995. Redemptive communities: Indigenous knowledge, colonist farming systems, and conservation of tropical forests. *Agriculture and Human Values* 12(1): 17–30.

Carr, D.L. 2002. *Rural-Frontier Migration and Deforestation in the Sierra de Lacandon National Park, Guatemala.* Unpublished Doctoral Dissertation. University of North Carolina, Chapel Hill, NC.

Carr, D., Barbieri, A.F. & Bilsborrow, R.E. 2003. *Population, Agricultural Land Use, and the Environment in Latin America at the Turn of the Millenium.* Proceedings of Open Meeting of the Human Dimensions of Global Environmental Change Research Community. October 16-18. Montreal, Canada. Available: www.ciesin.edu.

Carter, J. 1983. The development of wildlife management areas. In *Which Way Botswana's Wildlife?* Proceedings from the Symposium of the Kalahari Conservation Society. pp. 63–73. Gaborone, Botswana.

Cassels, S., Curran, S.R. & Kramer, R. 2005. Do migrants degrade coastal environments? Migration, natural resource extraction and poverty in North Sulawesi, Indonesia. *Human Ecology* 33(3): 329-363

Castles, S. & Miller, M.J. 1998. *The Age of Migration: International Population Movements in the Modern World.* London, UK: Macmillan.

Chibememe, G. June 2004. *The Relationship Between Biodiversity and Health With Particular Reference to HIV/AIDS: A Community Perspective.* Workshop on Health, Poverty and Conservation; 4th Regional Session, Southern and Eastern Africa Global Biodiversity Forum. June 9–11, Dar es Salaam. Available: www.undp.org/equatorinitiative/equatordialogues/events. December 19, 2006.

Chungyalpa, D. 2006. Personal Communication. Priority leader, Mekong Basin, World Wildlife Fund. May 31.

(CI) Conservation International. 2003. *Indigenous Peoples and Conservational International: Principles for Partnerships.* Washington, DC: Conservation International.

CI. 2005. *Combining Conservation and Care: Lessons Learned From Population Environment Initiatives.* Washington, DC: Conservation International.

CI Center for Applied Biodiversity Science and Institute for Social and Environmental Studies of Southern Bahia. 2000. *Designing Sustainable Landscapes: The Brazilian Atlantic Forest.* Washington, DC: Conservation International.

CI Mexico Program. 2002. PowerPoint presentation: Evaluación de afectaciones e impactos causados por las invasiones y ocupaciones irregulares a las áreas naturales protegidas de la Selva Lacandona de Chiapas (1994–2002). Chiapas, Mexico.

Cincotta, R. & Engelman, R. 2000a. *Nature's Place: Human Population and the Future of Biological Diversity.* Washington, DC: Population Action International.

Cincotta, R. & Engelman, R. 2000b. Biodiversity and population growth. *Issues in Science and Technology* 16(3): 80–81.

Clay, J. 2004. *World Agriculture and the Environment: A Commodity-by-Commodity Guide to Impacts and Practices.* Washington, DC: Island Press.

Clement C.R. & Higuchi, N. 2006. A Floresta Amazonica e o Futuro do Brasil. *Ciencia e Cultura* 58(3): 44–49.

Cullen, L., Alger, K. & Rambaldi, D.M. 2005. Land reform and biodiversity conservation in Brazil in the 1990s: Conflict and the articulation of mutual interests. *Conservation Biology* 19(3): 747–755.

Curran, S.R. & Agardy, T. 2002. Common property systems, migration, and coastal ecosystems. *Ambio* 31(4): 303-305.

D'Agnes, H. 2006. Personal Communication. Population-environment technical advisor, USAID. August 4.

da Fonseca, G.A.B., Schrest, W. & Oglethorpe, J. 2005. Managing the matrix. In T.E. Lovejoy & L. Hannah (Eds.), *Climate Change and Biodiversity.* 346-358. New Haven, CT: Yale University Press.

de Sherbinin, A. & Freudenberger, M. 1998. Migration to protected areas and buffer zones: Can we stem the tide? *Parks* 8(1): 38–53.

De Souza, R.M., Williams, J.S. & Meyerson, F.A.B. 2003. Critical links: Population, health and environment. *Population Bulletin* 58(3).

Deverall, E. & Lennon, S. 2005. *The Fijian Sugar Industry: Investing in Sustainable Technology.* Oxfam Briefing Paper No. 77. Oxfam International. Online. Available: www.oxfam.org.uk/what_we_do/issues/trade/downloads/bp77_sugar.pdf. 19 December, 2006

Diamond, J. 1999. *Guns, Germs and Steel: The Fates of Human Societies.* New York, NY: Norton & Co. Inc.

Dignan, T., Haynes, K., Conway, D. & Shrestha, N.R. 1989. Land and landlessness among rural-to-rural migrants in Nepal's Terai region. *International Regional Science Review* 12(2): 189–209.

Dwasi J. 2006. Personal Communication. Faculty of Law, University of Nairobi, Kenya. February 1.

Ellis, F. 2000. *Rural Livelihoods and Diversity in Developing Countries.* Oxford, UK, and New York: Oxford University Press.

Ericson, J. 2004. *Migration and Biodiversity Conservation: Implications and Interventions.* Washington, DC: Community Conservation Coalition, unpublished.

Ericson, J. & Freudenberger, M. 1998. *Population Monitoring System for the Calakmul Biosphere Reserve: Statement of Principles, Strategies, and Options.* Internal report. Washington, DC: World Wildlife Fund.

Ericson, J., Boege, E., & Freudenberger, M. 1998. *Population Dynamics, Migration, and the Future of the Calakmul Biosphere Reserve.* Program on Population and Sustainable Development Occasional Paper No. 1. Washington, DC: American Association for the Advancement of Science.

Ewing, R., Kostyack, J., Chen, D., Stein, B. & Ernst, M. 2005. *Endangered by Sprawl: How Runaway Development Threatens America's Wildlife.* Washington, DC: National Wildlife Federation, Smart Growth America and NatureServe.

(FAO) Food and Agriculture Organization of the United Nations. 1997. *State of the World's Forests.* Oxford, UK: Words and Publications.

FAO. 2001. *The Global Forest Resources Assessment 2000: Summary Report.* Rome, Italy: FAO, Committee on Forestry. Available: www.fao.org/forestry/fo/fra. June 30, 2006.

Freudenberger, M. 2006. Personal Communication. Regional coordinator, Ecoregional Initiatives Fianaransoa, Madagascar, Development Alternatives, Inc. July 27.

Frey, A. 2004. *Land law legislation.* MozLegal Lda: Maputo, Mozambique. Available: http://www.mozlegal.com/pt/legislation_portal/land_legislation. December 26, 2006

Geist, H.J. & Lambin, E.F. 2002. Proximate causes and underlying driving forces of tropical deforestation. *Bioscience* 52(2): 143–150.

Gelman, N.B., Oglethorpe, J. & Mauambeta, D. 2006. The impact of HIV/AIDS: How can it be anticipated and managed? *Parks* 15(1): 13-24.

Global Commission on International Migration. 2006. Migration at a Glance. Available: www.gcim.org. September 10, 2006.

Goeltenboth, P. 2006. Personal Communication. Coastal East Africa priority leader, WWF-US. May 31.

Goldstein, S. & Goldstein, A. 1981. The impact of migration on fertility: An Own C hildren' analysis for Thailand. *Population Studies* 35(2): 265–284.

Gorenflo, L.J. & Brandon, K. 2005. Agricultural capacity and conservation in high biodiversity forest ecosystems. *Ambio* 34(3):199-204.

Grandia, L. 2005. Personal Communication. Board of directors, ProPeten. August 29.

Grandia, L. 2006. *Unsettling: Land Dispossession of the Q'eqchi' Maya in the Frontier Colonization Process to the Guatemalan and Belizean Lowlands.* Published Doctoral Dissertation. Department of Anthropology, University of California, Berkeley, CA.

Grandia, L., Schwartz, N., Corzo, A., Obando, O. & Ochoa, L.H. 2001. *Peten's Integrated Demographic and Health Survey 1999: Report on the Module on Migration and Resource Use and Their Relationship With Conservation and Maternal-Child Health in Guatemala's Northern Frontier.* Collaborative report. Guatemala City: Instituto Nacional de Estadistica and United States Agency for International Development; Guatemala City: MEASURE DHS+; Calverton, MD: Macro International Inc.

Hansen, L.J., Biringer, J.L. & Hoffman, J.R. 2003. *Buying Time: A User's Manual for Building Resistance and Resilience to Climate Change in Natural Systems.* Washington, DC: World Wildlife Fund.

Hardcastle, J. 2004. Personal Communication. WWF Vietnam program development coordinator. April 12.

Hardin, G. 1968. The tragedy of the commons. *Science* 162(3859): 1243–1248.

Hart, T. 2005 A hole in the forest. *National Geographic Magazine* 208(3): 96–99.

Hart, T. & Hart, J. 2003. Rules of engagement. *Conservation in Practice* 4(1): 14–22.

Hart, T. & Mwinyihali, R. 2001. *Armed Conflict and Biodiversity in Sub-Saharan Africa: The Case of the Democratic Republic of Congo (DRC).* Washington, DC: Biodiversity Support Program, World Wildlife Fund.

Hatton, J., Couto, M. & Oglethorpe, J. 2001. *Biodiversity and War: A Case Study From Mozambique.* Washington, DC: Biodiversity Support Program, World Wildlife Fund.

Hays, P. & Vieira, R. Undated. *Mercury Contamination, a Legacy to Handicap a Generation.* WWF Guianas Regional Program Office Technical Paper Series #2. Paramaribo, Suriname: World Wildlife Fund.

Hecht, S. 1985. Environment, development, and politics: Capital accumulation and the livestock sector in eastern Amazonia. *World Development* 13(6): 663–684.

Hecht, S. & Cockburn, A. 1990. *The Fate of the Forest.* New York: Harper Collins.

Henriques, M.H. 1983. The colonization experience in Brazil. In A. Oberai (Ed.), *Land Settlement Policies and Population Redistribution in Developing Countries.* 316-354. New York and London: Praeger.

Henriques, M.H. 1985. The demographic dynamics of a frontier area: The case of Rondonia, Brazil. In R.E. Bilsborrow & P. DeLargy (Eds.), *Impact of Rural Development Projects on Demographic Behavior.* 133-168. Policy Development Studies No. 9. New York: UN Fund for Population Activities.

Holmberg, J. & Lundgren L. 2006. *Greater Mekong Subregion: Core Environmental Programme and Biodiversity Conservation Corridors Initiative: An Appraisal for SIDA.* Unpublished document.

(ILO) International Labour Organization. 1989. Convention Concerning Indigenous and Tribal Peoples in Independent Countries. Adopted by the General Conference of the International Labour Organization on June 27, 1989. Geneva, Switzerland: International Labour Organization.

Institute for Liberty and Democracy. 2006. Achievements, Annex 1, Documented Impact of ILD's Reforms. Online. Available: www.ild.org.pe/pdf/Annex_01.pdf. July 26, 2006.

Instituto Socioambiental. 2006. *Amazonia Brasileira 2006: Edicao Especial, Programa Areas Protegidas da Amazonia/MMA.* Sao Paulo: Instituto Socioambiental.

Irvine, D. 2000. Indigenous federations and the market: The Runa of Napo, Ecuador. In R. Weber, J. Butler & P. Larson (Eds.), *Indigenous Peoples and Conservation Organizations: Experiences in Collaboration.* Washington, DC: World Wildlife Fund.

Jacobson, K. 1994. *The Impact of Refugees on the Environment: A Review of the Evidence.* Washington, DC, and Geneva, Switzerland: Refugee Policy Group.

Kaimowitz, D., Thiele, G. & Pacheco, P. 1999. The effects of structural adjustment on deforestation and forest degradation in lowland Bolivia. *World Development* 27(3): 505–520.

Karesh, W.B., Cook, R.A., Bennett, E.L., Newcomb, J. 2005. Wildlife trade and global disease emergence. Emerg Infect Dis. Online. Available: http://www.cdc.gov/ncidod/EID/vol11no07/05-0194.htm. 15 July 2005.

Keele B.F., Van Heuverswyn F., Li Y., Bailes, E., Takehisa, J., Santiago, M.L., Bibollet-Ruche, F., Chen, Y., Wain, L. V., Liegeois, F., Loul, S., Ngole, E.M., Bienvenue, Y., Delaporte, E., Brookfield, J.F.Y., Sharp, P.M., Shaw, G. M., Peeters, M. and Hahn, B.H. 2006. Chimpanzee Reservoirs of Pandemic and Nonpandemic HIV-1. *Science* 313: 523-526.

Kerr, S., Cardenas, S. & Hendy, J. 2004. *Migration and the Environment in the Galapagos: An Analysis of Economic and Policy Incentives Driving Migration, Potential Impacts From Migration Control, and Potential Policies to Reduce Migration Pressure.* Motu Working Paper 2003-17. Wellington, New Zealand: Motu Economic & Public Policy Research.

Kissling, E., Allison, E.H., Seeley, J.A., Russell, S., Bachmann, M., Musgrave, S.D. & Heck, S. 2005. Fisherfolk are among groups most at risk of HIV: Cross-country analysis of prevalence and numbers infected. *AIDS* 19(17): 1939–1946.

Klein, R.J.T., Nicholls, R.J. & Thomalla, F. 2002. The resilience of coastal megacities to weather-related hazards: A review. In A. Kreimer, M. Arnold & A. Carlin (Eds.), *Proceedings of the Future of Disaster Risk: Building Safer Cities.* pp. 111–137. Washington, DC: The World Bank.

Kramer, R.A., Simanjuntak, S.M.H. & Liese, C. 2002. Migration and fishing in Indonesian coastal villages. *Ambio* 31(4): 367-371.

Lee, E. 1966. A theory on migration. *Demography* 3(1): 47–57.

Lonergan, S. 1998. The role of environmental degradation in population displacement. *Environmental Change and Security Project Report* 4 (Spring): 5–15. Washington, DC: The Woodrow Wilson Center

Lovejoy, T.E. & Hannah, L. (Eds.) 2005. *Climate Change and Biodiversity.* New Haven, CT: Yale University Press.

Manandhar, A. 2006. Personal Communication. Conservation director, World Wildlife Fund Nepal. August 31.

Margoluis, C. 2004. *Tragic Choices and Creative Compromises: Managing Protected Areas With Human Settlements.* Unpublished Doctoral Dissertation. Yale University, New Haven, CT.

Massey, D. 1990. Social structure, household strategies, and the cumulative causation of migration. *Population Index* 56(1): 3–26.

Massey, D.S., Arango, J., Hugo, G., Kouaouci, A., Pellegrino, A. & Taylor, J.E. 1993. Theories of international migration: A review and appraisal. *Population and Development Review* 19(3): 431–466.

McGranahan G., Balk, D. & Anderson, B. 2006. Low Coastal Zone Settlements. *Tiempo* 59: 23–26. Available: http://www.tiempocyberclimate.org. December 16, 2006.

McLeman, R. & Smit, B. 2006. Migration as an adaptation to climate change. *Climate Change* 76: 31–53.

McNeely, J. 2000. War and biodiversity: An assessment of impacts. In J. Austin & C. Bruch (Eds.), *The Environmental Consequences of War: Legal, Economic, and Scientific Perspectives.* pp. 353–369.Cambridge, UK: Cambridge University Press.

Migration Policy Institute. 2006. *Migration Information Source Glossary.* Online. Available: http://www.migrationinformation.org/Glossary. November 15, 2006.

Milne, S. 2005. Personal Communication. Community program manager, Cambodia Program, Conservation International. May 12.

Minten, B. 2006. Trade Liberalization, Rural Poverty and the Environment: The Case of Madagascar. Washington, D.C: Macroeconomics Program Office, WWF.

Mogba, Z. & Freudenberger, M. 1997. *Human Migration in the Protected Zones of Central Africa: The Case of the Dzanga-Sangha Special Reserve.* Paper presented at Sangha River Network Conference. September 1997. Yale University, New Haven, CT.

Mogba, Z., Freudenberger, M., Zana, H. & Missosso, M. 1996. *Human Migration and Its Impacts on Conservation of Natural Resources in the Dzanga-Sangha Special Reserve: A Case Study of the Diamond Economy of Ndelengue, Central African Republic.* Washington, DC: World Wildlife Fund.

Montoya, J. 2006. Personal Communication. Senior program officer, Chihuahuan Desert Program, WWF. June 16.

Morris, N.T., Paiva, R.G. & Gallagher, D.O. 1996. *Environmentally-Induced Population Displacements and Environmental Impacts Resulting From Mass Migrations.* International Symposium. April 21–24, Geneva. Geneva, Switzerland: International Organization for Migration.

Myers, N., Mittermeier, R., Mittermeier, C.G., da Fonseca, G.A.B. & Kent, J. 2000. Biodiversity hotspots for conservation priorities. *Nature* 403: 853–858.

Nations, J.D. 2006. *The Maya Tropical Forest: People, Parks, and Ancient Cities.* Austin, TX: University of Texas Press.

Nicholls, R.J. & Lowe, J.A. 2006. Climate stabilisation and impacts of sea-level rise. In H.J. Schellnhuber, W. Cramer, N. Nakicenovic, T. Wigley & G. Yohe (Eds.), *Avoiding Dangerous Climate Change.* Cambridge, UK: Cambridge University Press.

Nyong, A. & Niang-Diop, I. 2006. Impacts of climate change in the tropics: The African experience. In H.J. Schellnhuber, W. Cramer, N. Nakicenovic, T. Wigley & G. Yohe (Eds.), *Avoiding Dangerous Climate Change.* Cambridge, UK: Cambridge University Press.

Oberai, A. & Bilsborrow, R.E. 1984. Theoretical perspectives on migration. In R.E. Bilsborrow, A.S. Oberai, & G. Standing (Eds.), *Migration Surveys in Low-Income Countries: Guidelines for Survey and Questionnaire Design.* Chapter 2. London and Sydney, Australia: Croom Helm, for the International Labour Office.

Oglethorpe, J. & Gelman, N. 2004. *HIV/AIDS and Conservation: Impacts and Ways to Reduce Them.* Fact sheet for the conservation community. Washington, DC: World Wildlife Fund and Africa Biodiversity Collaborative Group. Online. Available: http://www.abcg.org. December 19, 2006

Osofsky, S.A., Cleaveland, S., Karesh, W.B., Kock, M.D., Nyhus, P.J., Starr, L. & Yang, A. (Eds.). 2005. *Conservation and Development Interventions at the Wildlife/Livestock Interface: Implications for Wildlife, Livestock and Human Health.* Gland, Switzerland, and Cambridge, UK: IUCN.

PAD Partnership. 2003. *Cambodia: National Report on Protected Areas and Development. Review of Protected Areas and Development in the Four Countries of the Lower Mekong River Region.* Queensland, Australia: International Centre for Environmental Management.

Palloni, A., Massey, D.S., Ceballos, M., Espinosa, K. & Spittel, M. 2001. Social capital and international migration: A test using information on family networks. *American Journal of Sociology* 106(5): 1262–1298.

Panuncio, M. 2006. Personal Communication. Senior program officer, Amazon Program, WWF-US. November 6.

Perl, M. 2006. Personal Communication. Director, Amazon Regional Protected Areas, World Wildlife Fund. July 8.

Pichón, F.J. 1992. Agricultural settlement and ecological crisis in the Ecuadorian Amazon frontier—a discussion of the policy environment. *Policy Studies Journal* 20(4): 662–678.

Pichón, F.J. 1997. Colonist land allocation decisions, land use and deforestation in the Ecuadorian Amazon frontier. *Economic Development and Cultural Change* 45(4): 707–744.

Pichón, F.J. & Bilsborrow, R.E. 1999. Land-use systems, deforestation, and demographic factors in the humid tropics: Farm-level evidence from Ecuador. In R.E. Bilsborrow and D. Hogan (Eds.), *Population and Deforestation in the Humid Tropics.* 175-207. Liege, Belgium: International Union for the Scientific Study of Population.

Piore, M. J. 1979. Birds of Passage: Migrant Labor in Industrial Societies. New York: Cambridge University Press.

Quinn, T.C. 1994. Population migration and the spread of type-1 and type-2 human immunodeficiency viruses. *Proceedings of the National Academy of Sciences of the United States of America* 91(7): 2407–2414.

Reno, W. 2001. The failure of peacekeeping in Sierra Leone. *Current History* 100(646): 219–225.

Rudel, T. & Horowitz, B. 1993. *Tropical Deforestation: Small Farmers and Forest Clearing in the Ecuadorian Amazon.* New York: Columbia University Press.

Rudel, T. & Roper, J. 1997. The paths to rain forest destruction: crossnational patterns of tropical deforestation, 1975–90. *World Development* 25(1): 53–65.

Rudel, T.K., Bates, D. & Machinguiashi, R. 2002. A tropical forest transition? Agricultural change, out-migration, and secondary forests in the Ecuadorian Amazon. *Annals of the Association of American Geographers* 92(1): 87–102.

Ruiz, L. & Bilsborrow, R.E. 1990. Evaluacion del Impacto Demografico de proyectos de Desarrollo Rural Integral Demographic Impacts of Integrated rural Development Projects in Ecuador. *Forum Valutazione* (Rome), Vol 0: 175-207.

Rupeni E. 2005. Personal Communication. Fiji country manager, WWF South Pacific Programme Office. 2 February.

Sawyer, D. & Rigotti, J.I.R. 2001. *Migration and Spatial Distribution of Rural Population in Brazil, 1950–2050.* Presented at the XXIV General Population Conference, International Union for the Scientific Study of Population. August 18–24, Salvador Bahia, Brazil.

Schmink, M. & Wood, C. 1993. *Contested Frontiers.* New York: Columbia University Press.

Scholte, P. 2003. Immigration: A potential time bomb under the integration of conservation and development. *Ambio* 32(1): 58–64.

Segee, B.P. & Neeley, J.L. 2006. *On the Line: The Impacts of Immigration Policy on Wildlife and Habitat in the Arizona Borderlands.* Washington, DC: Defenders of Wildlife.

Shambaugh, J., Oglethorpe, J. & Ham, R. 2001. *The Trampled Grass: Mitigating the Impacts of Armed Conflict on the Environment.* Washington, DC: Biodiversity Support Program and World Wildlife Fund.

Skeldon, R. 1990. *Population Mobility in Developing Countries: A Reinterpretation.* London and New York: Belhaven Press.

Soudre, K. 2006. Personal Communication. Forest specialist, WWF Peru Program Office. November 28.

Spurrier, L. 2006. Personal Communication. Managing director for the Galapagos Department, WWF. June 2.

Tiffin, M. & Mortimore, M. 1992. Environment, population growth and productivity in Kenya: A case study of Machakos District. *Development Policy Review* 10: 359–387.

Tshombe, R. 2005. Personal Communication. Director, Wildlife Conservation Society, Democratic Republic of Congo. May 16.

(UN) United Nations. 2001. *Road Map towards the Implementation of the United Nations Millennium Declaration: Report of the Secretary General.* United Nations General Assembly A/56/326. New York: United Nations.

UN. 2002. *World Urbanization Prospects: The 2001 Revision.* New York: United Nations.

UN. 2004. *World Urbanization Prospects: The 2003 Revision.* New York: United Nations.

UN. 2005. *World Population Prospects: The 2004 Revision.* New York: Population Division of the Department of Economic and Social Affairs of the UN Secretariat.

UN. 2006. *Trends in Total Migrant Stock: The 2005 Revision.* New York: Population Division of the Department of Economic and Social Affairs of the UN Secretariat.

(UNEP)United Nations Environment Program. 2001. *Bhutan: State of the Environment Report.* Thailand: UNEP Regional Resource Center for Asia and Pacific.

(UNESCO) United Nations Educational, Scientific and Cultural Organization. 2006. Social and Human Sciences Social Transformations Themes, Glossary of Migration Related Terms. Online. Available: http://www.unesco.org/shs/migration/glossary. July 2006.

(UNHCR) United Nations High Commissioner for Refugees. 2000. *The State of the World's Refugees: Fifty Years of Humanitarian Action.* Oxford, UK: Oxford University Press.

UNHCR. 2005. *UNHCR Environmental Guidelines.* Geneva, Switzerland: UNHCR.

(USAID) United States Agency for International Development. 2006. International Family Planning Saves the Earth. Online. Available: http://www.usaid.gov/our_work/global_health/pop/news/earth_day06.html. July 31, 2006.

Valdivia, G. 2005. On indigeneity, change, and representation in the northeastern Ecuadorian Amazon. *Environment and Planning A* 37(2): 285–303.

van Breda, A. 2006. Personal Communication. Director, Relief Sector Partnerships, WWF. August 9.

van de Veen, H. & BureauM&O. 2005. *Managing the Miombo: Economic Crisis Threatens People and Nature in Zambia's Copperbelt.* Gland, Switzerland: WWF DGIS-TMF Programme.

Williams, M.J. 2002. Technology, knowledge systems, population dynamics, and coastal ecosystems. *Ambio* 3(4): 337–339.

Wilson, D. & Purushothaman, R. 2003. *Dreaming with BRICS: The Path to 2050.* Goldman Sachs Global Economics Paper Number 99. New York, NY: Goldman Sachs Group Inc.

Wood, C.H. & Porro, R. 2002. *Deforestation and Land Use in the Amazon.* Gainesville, FL: University Press of Florida.

Wood, C.H., Skole, D., Perz, D. & Caetano, A. 1996. *Population and Deforestation in the Brazilian Amazon.* Paper presented at 1996 Annual Meeting of Population Association of America. May 9–11, New Orleans, LA.

Wood, W.B. 1994. Forced migration—local conflicts and international dilemmas. *Annals of the Association of American Geographers* 84(4): 607–634.

World Bank. 2004. *Operational Manual 4.12 – Involuntary Resettlement (revised April 2004)* Washington, DC: World Bank.

World Commission on Dams. 2000. *Dams and Development: A New Framework for Decision-making.* London: Earthscan Publications. Available: http://www.dams.org/report/. September 6, 2006.

(WWF) World Wildlife Fund. 1996. *Indigenous Peoples and Conservation: WWF Statement of Principles.* WWF International position paper. Gland, Switzerland: World Wildlife Fund.

WWF Center for Conservation Strategies. 2002. *Mapping the Connections: The Population-Environment Lessons From Madagascar.* Washington, DC: World Wildlife Fund.

WWF Conservation Strategies Unit. 2001. *Disappearing Landscapes: The Population/Environment Connection.* Washington, DC: World Wildlife Fund.

WWF Madagascar Program. Undated. *Present Migration Tendencies and Related Social and Environmental Impacts in Madagascar's Spiny Forest Ecoregion.* Summary of Fenn, Koto, Robinson, & Whynner, 1999, *Les tendances actuelles de la migration des peoples et son impact dans la region ecologique des forets epineuses a Madagascar.* Antananarivo: WWF Madagascar Program Office.

CASE STUDIES

Africa and Madagascar

Democratic Republic of the Congo, Okapi Faunal Reserve 66
Cameroon, Waza-Logone Area 67
Zambia, Copperbelt Region 68
Central African Republic, Including Dzanga-Sangha Special Dense Forest Reserve 70
Madagascar, Spiny Forest Region 71

Asia

Vietnam, Greater Annamites Ecoregion 74
Nepal, Part of the Terai Arc 76
Cambodia, Central Cardamom Protected Forest 77

Latin America

Brazil, Atlantic Forest 80
Colombia, National Parks 82
Ecuador, Galapagos Islands 83
Mexico, Lacandón Forest 85
Guatemala, Maya Biosphere Reserve 87

Democratic Republic of the Congo Okapi Faunal Reserve

Demographics of Migration (including place of origin)

In 1990, the population in and around the Okapi Faunal Reserve was estimated at 15,600 inhabitants (UNEP 2002). At the time there were few permanent settlements in the region. The road system was in a state of decay, and there was very little gold-mining activity. Beginning in 1996, Rwandan Interahamwe and Congolese Mayi-Mayi armed rebel factions led an insurgency that resulted in battle against government troops. There was also increasing encroachment of Nande and urban Bantu in-migrant cultivators due to disturbances in Kivu to the south. This was followed in 2000–2001 by an inrush of approximately 4,000 coltan miners responding to the brief 10-fold price increase of coltan (a mineral used in computer chips) on the world market (Hart & Hart 2003). Both the armed militias and the miners heavily impacted the local wild animal populations in their search for bushmeat.

Conservation Issues

Values – Located in the Congo River Basin, the Okapi Faunal Reserve occupies 13,726 square kilometers, about one-fifth of the Ituri Forest. It is part of the home range of the nomadic Mbuti Pygmies and contains numerous threatened species of primates and birds. In 1986 the Ituri Forest contained more than 4,000 of the estimated 30,000 okapi (*Okapia johnstoni*) remaining in the wild (UNEP 2002). The Okapi Faunal Reserve is considered to be only partially protected and, until recently, was largely inaccessible due to armed conflict in the region (Inogwabini *et al.* 2005). In the Democratic Republic of the Congo (DRC), faunal reserves are designed to protect wildlife while allowing regulated human activity such as hunting and housing.

Threats – The major threats are insurgency and armed conflict due to civil unrest; competition over hunting for gold, diamonds and coltan; elephant and gorilla poaching and bushmeat hunting; forest clearing for fuel, charcoal, house construction and agriculture; and logging. Due to the conflicts, reserve and other conservation staff were evacuated in early 1997. The Okapi Faunal Reserve was placed on the World Heritage Sites in Danger list in 1998. Animal populations around the mining camps have been severely impacted, and the hunter-gatherer Mbutu Pygmy way of life is increasingly threatened.

Driving Forces

Push Factors – Refugees fleeing conflict found their way into the forests early in the war. In 1996, reserve guards were disarmed by the Rwandan army and forbidden to patrol. Armed civil rebellions occurred in the area in 1997 and 1998, and inside the reserve in 2002 (Hart 2005).

Pull Factors – Migrants are attracted to the region by prospects for employment in the gold and coltan mines. Well-established gold mining camps with administration, including police and tax collection systems, also attract settlers who clear land to cultivate gardens to feed the miners. There is abundant bushmeat in the tropical rain forest, and the elephants are exploited for ivory trade. A substantial temporary increase in the world price of coltan in 2000–2001 attracted investment in facilities and miners.

Interventions

Influencing Migration – As part of a zoning program, the World Conservation Society (WCS) has facilitated the collection and analysis of population census data in and around the reserve. The initial plan was to conduct a census every five years. Due to armed conflict in the region, it was impossible in 1998 to update the initial census of 1993–1994, so the team had to wait until 2003 to conduct an update. Census data have been collected in Mbutu Pygmy camps and in more than 100 villages, most of which are located in Mambasa Territory. Approximately 95 percent of the reserve is located in Mambasa Territory; 3 percent is located in Wamba Territory, which has the highest population; and 2 percent is located in Watsa Territory. The 2003 data collection team consisted of approximately 20 people. The results of the two censuses show an increase of 26,000 people over the 10-year period (Tshombe, pers. comm. 2005).

Reducing Impacts of Migrants (in destination area) – International investment and support for conservation prior to and during the regional war have helped reduce impacts. According to John and Terese Hart (2003:17), who have spent many years working in the Okapi, "The individuals who took the greatest risks [in support of conservation during the war] had a clear sense of their professional mandate and had confidence that they would continue to receive outside support to fulfill that mandate." In addition, troops have shown greater respect for populations of captive and closely monitored wildlife, namely the okapi in the Okapi Faunal Reserve and habituated gorilla families in the nearby Kahuzi-Biega National Park, than for free-ranging and unmonitored wildlife in the area. Also, a zoning project is underway at multiple levels (local territory,

province and national) to ensure that the accords worked out locally become official and receive support at each level. The presence of on-the-ground dedicated national staff, both university-educated professionals and well-trained park guards, is an important field-based accomplishment, as is the formation of local, consensus-based site management teams to advise and support wardens.

Contacts

Linde Ostro (WCS);

Terese Hart (WCS);

Richard Tshombe (WCS)

References

Inogwabini, B., Ilambu, O. & Gbanzi, M.A. 2005. Protected areas of the Democratic Republic of Congo. *Conservation Biology* 19(1): 15–22.

Hart, T. 2005. A hole in the forest. *National Geographic Magazine* 208(3): 96–99.

Hart, T. & Hart, J. 2003. Rules of engagement. *Conservation in Practice* 4(1): 14–22.

Tshombe, R. 2005. Personal Communication. Director, Wildlife Conservation Society, Democratic Republic of the Congo. May 16.

(UNEP) United Nations Environment Program, Protected Areas Program. 2002. Okapi Faunal Reserve, Democratic Republic of the Congo. Online. Available: http://www.unep-wcmc.org/sites/wh/okapi.htm. September 3, 2004.

Notes – The Okapi Faunal Reserve is one of a number of protected areas in the Congo Basin and the Albertine Rift region. Internally displaced peoples and military factions from DRC, Uganda, Rwanda and elsewhere have had huge biodiversity impacts in recent years, especially in the eastern DRC.

Cameroon
Waza-Logone Area

Demographics of Migration (including place of origin)

In 1979, a large hydroelectric dam was constructed upstream from the Waza-Logone area near Lake Maga, causing changes in the hydrological regime and a dramatic decline in fishing resources. As a result, about 40 percent of the local population left the area, and a large part of the remaining population was forced to shift their livelihoods from fisheries to animal husbandry and agriculture. In 1994, a portion of the area was reflooded as part of an Integrated Conservation and Development Project (ICDP) initiated by a Cameroonian environmental NGO, the Committee for the Support of Conservation and Sustainable Development Initiatives (CACID). The reflooding enabled many people to return to the area. From 1994 to 1996, the number of households in each of the Waza National Park villages increased by 3 percent annually due to immigration (Scholte 2003).

Conservation Issues

Values – The area containing the Waza and Kalamaloue National Parks covers 8,000 square kilometers in the Sahelo-Sudanian zone. It is one of the principal waterfowl areas in west-central Africa due to the vastness of the Logone flood plain. It contains numerous species of large mammals that depend on the annual inundation of the flood plain. These include elephants (*Loxodonta africana*), giraffes (*Giraffa camelopardalis*), hippopotamus (*Hippopotamus amphibious*), seven antelope species, three primate species, warthogs (*Phacochoerus africanus*), lions (*Panthera leo*) and spotted and striped hyenas (*Crocuta crocuta, Hyaena hyaena*).

Threats – The major threats are poaching, agriculture, livestock intrusion, fuelwood extraction and fishing inside the parks by community members living inside and on the park borders. Dramatic declines in wildlife numbers, especially kob antelope (*Kobus kob*), have occurred since 1977. The waterbuck (*Kobus ellipsiprymnus*) has become extinct in Kalamaloue National Park, probably due to reduction in dry-season forage caused by changes in the water regime because of the dam construction.

Driving Forces

Push Factors – Seasonally dry conditions outside the park.

Pull Factors – Under the ICDP program, reflooding of the area brought immediate improvement in fishing and

pastoral conditions and caused a wave of in-migration. Some of these migrants were returning residents who had lived there prior to construction of the dam. During the dry season, depressions outside the Waza National Park dry up several weeks earlier than those inside. The presence of water inside the park draws livestock and increases the number of pastoral camps. People are drawn into the park in search of better places to fish and graze their livestock. Lack of land titles and an open access system have also drawn people to the area.

Interventions

Influencing Migration – An effort was conducted to categorize stakeholders and identify local user and stakeholder groups based on territory, activities undertaken and kinship. This project has triggered discussion regarding demographics and possible immigration control policies (Scholte 2003).

Reducing Impacts (destination) – CACID has facilitated the establishment of a collaborative management committee composed of Waza National Park management staff and representatives of villages with territories located outside the park (Equator Initiative 2003). ICDP project benefits are linked to representation on the committee, so only members of villages located outside of the park are eligible to receive benefits. This strategy has resulted in the voluntary relocation of a number of families previously living inside the park to villages outside the park boundaries. As incentives for moving outside of the park, these families receive benefits such as access to water pumps (Scholte 2003). The project has provided clean water access from 37 wells in 33 villages as well as training in health and sanitation. The emphasis on clean water has reduced the occurrence of diarrhea in the region by 70 percent (Equator Initiative 2003).

Contacts

Paul Scholte (Leiden University, The Netherlands);

Committee for the Support of Conservation and Sustainable Development Initiatives (CACID), Cameroon.

References

Equator Initiative. 2003. Online. Available: http://www.tve.org/ho/doc.cfm?aid=975&lang=English. November 12, 2006.

Scholte, P. 2003. Immigration: A potential time bomb under the integration of conservation and development. *Ambio* 32(1): 58–64.

Zambia
Copperbelt Region

Demographics of Migration (including place of origin)

The Miombo ecoregion covers approximately 3.6 million square kilometers and contains an estimated 65 million people spanning 10 countries. One of these countries is Zambia. Within Zambia, population growth is highest in the Copperbelt region, mainly due to the influx of migrants drawn by the mining industry from other provinces and neighboring countries such as the Democratic Republic of Congo. However, the copper mining industry of Zambia has been in decline over the past few decades due to a fall in the world price of copper, lack of investment and uncertainty over privatization. Mine closures have resulted in widespread unemployment. Former mine workers often move to the outskirts of urban areas or to rural parts of the Copperbelt, which have low population densities and offer opportunities in charcoal production or agriculture (WWF 2004).[1]

Conservation Issues

Values – The Miombo ecoregion is home to approximately half the elephants and rhinos left in Africa. About 12 percent of it is under protected area status. It also contains part of the catchment basins for some of the major southern African rivers—the Zambezi, Kavango and Congo—and for Lake Malawi/Niassa, Lake Tanganyika and the Okavango Delta. The Copperbelt area in northern Zambia lies in the Miombo ecoregion. It does not have large wildlife populations, but it has high plant diversity with numerous endemic species (56 species) confined to the mineral-rich toxic soils on copper outcrops. The vegetation is mostly wet miombo woodland with dambo grassland, swamp forest and dry evergreen forest.

Threats – Threats to biodiversity in the Copperbelt include deforestation and land clearing for human settlements and agricultural expansion, logging, small- and large-scale copper mining, road construction, other types of resource extraction such as charcoal production, fuelwood collection and pastoralism. Some of the underlying drivers of these

1 As this document was going to press, copper prices on the world market were beginning to stabilize, causing some dramatic changes in the Copperbelt. Old mines are becoming operational again and new mines are being created. This is triggering a new wave of migrants into the area. The extent to which former miners are received back into formal employment, coupled with the price of electricity, will determine how much of a return there will be from agriculture to mining (Gumbo, pers. comm. 2006).

threats include international demand for copper and timber; poor pricing for forest products; unfavorable land tenure; poverty; illegal activities; population growth; political corruption; lack of regulatory enforcement capacity; changing regional and national policies, including shift from command to market economy; and diversification of the national economic base from copper mining and agriculture to other industries. Also, national and international trends fueling demand for natural products, coupled with unsustainable harvesting practices, are contributing to loss of biodiversity in the area.

Driving Forces

Push Factors – Lack of employment opportunities in other provinces of Zambia and social unrest in neighboring DRC contribute to migration to the Copperbelt region. Declines in mining and associated industries are causing internal migration within the Copperbelt away from mining areas toward more rural areas and the outskirts of urban areas.

Pull Factors – Migrants are initially attracted to the region by opportunities in copper mining, mineral refinement and other economic activities, including agriculture, that support the mining sector. When mines within the region close, unemployed miners relocate to more rural, environmentally fragile areas. They are drawn to rural areas by opportunities for charcoal production and the availability of land to practice agriculture. Movement within the region is facilitated by good roads, high market value of agricultural and forest products (timber, honey, mushrooms, etc.) and available foreign markets (Europe, South Africa and Asia).

Interventions

Influencing Migration – WWF has proposed a strategy to encourage mining companies and local leaders to plan for the resettlement of displaced or retrenched workers so that they will not have to migrate toward more ecologically fragile rural areas. Suitable resettlement areas need to be identified where settlers can find income-generating activities that do not promote further environmental degradation.

Reducing Impacts of Migrants (in destination area) – Local-level institutions and leaders need to develop policies to influence how land is allocated in rural areas and how newly arriving settlers are accepted. Some of the key actions currently being implemented include promotion of sustainable wetland cultivation, development of sustainable charcoal production and formation of commodity groups, such as beekeeping and mushroom production.

Contacts

Davison Gumbo (WWF, Southern Africa Regional Program Office);

Newton Moyo (WWF, Zambia Country Office);

Celestine Lwatula (WWF, Zambia Country Office)

References

Gumbo, D. 2006. Personal Communication. Miombo Ecoregion leader, WWF Southern African Regional Program Office. August 6.

Njovu, F., Chuzu, P. & Nguvulu, C.Z. 2004. *Key Threats and Opportunities for Conservation of Biodiversity and Natural Resource in the Copperbelt Area of Biological Significance: An Analytical Interpretive Report.* Draft internal document. WWF Southern African Regional Program Office.

Van de Veen, H. 2005. *Managing the Miombo: Economic Crisis Threatens People and Nature in Zambia's Copperbelt.* Gland, Switzerland: WWF DGIS-TMF Programme.

(WWF) World Wildlife Fund, Africa Program. 2004. *Migration and Biodiversity Conservation in the Miombo: Case of the Copperbelt Area of Significance.* Internal document. Washington, DC: World Wildlife Fund.

Central African Republic Including Dzanga-Sangha Special Dense Forest Reserve

Demographics of Migration (including place of origin)

The southern region of the Central African Republic (CAR) has a long history of migration of people due to economic, political and social reasons. Today, in-migrants outnumber the local population and control most economic activities. Some migrants come from as far away as the Sahel regions of Senegal, Mauritania and Mali, while others come from the various savannah regions of the CAR itself, including Bossangoa, Berberati, Sangha-Mbarere and Ombella-Mpoko (Mogba & Freudenberger 1997).

Conservation Issues

Values – The Dzanga-Sangha Special Dense Forest Reserve and the Dzanga-Ndoki National Park in the southwestern region of the CAR are protected areas of international importance. They house diverse tropical flora and fauna, including one of the highest densities of western lowland gorillas and forest elephants in Africa (Blom 1998).

Threats – The main threats are poaching for bushmeat and ivory, unsustainable logging, diamond mining and swidden agriculture. All of these threats are linked to population growth, which is primarily due to in-migration. Although laws exist to mitigate many of these threats, enforcement is lacking, due primarily to weak government institutions and corruption.

Driving Forces

Push Factors – Rural and urban poverty is a major push factor, including the difficulty facing young, often educated people in finding paid employment in other parts of the country. Climatic and ecological changes, primarily in the neighboring Sahel regions of Senegal, Mauritania, Mali and other countries to the north and west, also cause people to migrate toward the CAR.

Pull Factors – The diamond-mining economy, driven by international capital primarily from Holland and Belgium, attracts migrants to the region with the promise of employment both in the mines and within the supporting infrastructure of merchants and services. Logging and timber extraction activities, which are also driven by international capital, draw migrants through employment opportunities and create a network of primary and secondary roads that facilitate economic development, colonization and environmental change. Administrative and private employment opportunities, including tourism, also attract migrants to the region. Sociocultural pressures, such as marriage-related migration, lead young women to follow husbands who work in the diamond mines or workers' complexes. Finally, an underlying open access system attracts migrants by enabling the extraction of natural resources without penalty.

Interventions

Influencing Migration – Revenue from tourism is shared with communities settled prior to the formation of the reserve, but not with the newly established communities. (Currently 90 percent of total revenue stays in local hands: 40 percent of it goes to local NGOs for clinics and road repair, 50 percent pays salaries of park staff and 10 percent goes to the national forestry fund.) WWF has proposed establishing a population-monitoring system to provide ongoing population census data and measure migration dynamics and impacts on the forest as a strategic opportunity for this region (Freudenberger, pers. comm. 2004).

Reducing Impacts of Migrants (in destination area) – In 2004, the number of trained park guards increased to 51. Zoning and law enforcement help restrict poaching and mining activities in the region. An agreement has been negotiated between the reserve and the surrounding mining communities, identifying areas that can and cannot be mined. Now, prospective diamond miners looking for new mining sites receive warnings when they are operating outside an authorized mining area. If they do not heed these warnings, their mining materials are confiscated and mining shanties located in restricted areas are burned. Poachers are arrested and their snares, guns and bushmeat are confiscated (Blom, pers. comm. 2004). It is no longer an open access system. This clear set of rules and corresponding enforcement have led to a substantial decrease in tension between the mining community and the reserve.

Contacts

Allard Blom (Deputy director, Congo Basin, WWF-US);

Mark Freudenberger (Ecoregional Initiatives, Fianarantsoa, Madagascar);

Richard Ruggiero (U.S. Fish & Wildlife Service)

References

Blom, A. 1998. A critical analyses of three approaches to tropical forest conservation based on experiences in the Sangha region. In R. Hardin, H.E. Eves & S. Rupp (Eds.), *Resource Use in the Trinational Sangha River*

Region of Equatorial Africa: Histories, Knowledge Forms, and Institutions. pp.208–215. New Haven, CT: Yale F&ES Bulletin 102.

Blom, A. 2004. Personal Communication. April 19.

Eves, H.E., Hardin, R., & Rupp, S. (Eds.) 1998. *Resource Use in the Tri-national Sangha River Region of Equatorial Africa: Histories, Knowledge Forms, and Institutions.* New Haven, CT: Yale F&ES Bulletin 102.

Freudenberger, M. 2004. Personal Communication. April 14.

Mogba, Z., Freudenberger, M., Zana, H. & Missosso, M. 1996. *Migrations humaines et leurs impacts sur la conservation des ressources naturelles dans la Reserve de Dzanga-Sangha: Etude de cas de l'economie de diamant a Ndelengue, Republique Centrafricaine.* Washington, DC: World Wildlife Fund.

Mogba, Z. & Freudenberger, M. 1997. *Human Migration in the Protected Zones of Central Africa: The Case of the Dzanga-Sangha Special Reserve.* Conference on Sangha River Network. September 25-28, 1997. New Haven, CT: Yale University.

Madagascar Spiny Forest Region

Demographics of Migration (including place of origin)

Migration across the Spiny Forest region is both seasonal (for transhumance and for salaried labor opportunities during the dry season) and permanent (resulting from extended periods of drought, lack of arable land, constrained economic opportunities, locust and exotic plant invasions, and most often a combination of these factors). The changing migration patterns and behavior of the Tandroy and Mahafaly populations, the main ethnic groups in southern Madagascar, have been identified as a principal cause of human population pressures on several biologically important sites in the ecoregion (Fenn & Rebara undated, WWF Madagascar undated). Added to the rural-to-rural migration patterns, an evolving urban exodus occurred in the past 10 years because of reduced employment opportunities and factory closings in the major towns of the region, such as Tulear and Fort Dauphin. This has caused migrants to settle in rural areas for forest-related economic opportunities. Migrants tend to settle and transform natural areas where weak governance structures exist with the local indigenous populations, such as the Masikoro. Forest resources are extracted first, and the land is subsequently farmed for cash crops, for both domestic consumption and export. According to the sources cited, migration is primarily internal to the region, moving from degraded landscapes to natural forest areas. Additionally, the risk of HIV spread in Madagascar is high. On mainland Africa, HIV/AIDS is having a serious impact on biodiversity (Gelman *et al.* 2006).

Conservation Issues

Values – The Spiny Forest region is an ecologically unique area that covers 66,000 square kilometers in southern and southwestern Madagascar. With 95 percent of its plant species endemic, the highest concentration of baobab species in the world and nine species of lemurs, the area is recognized as having an extremely high global priority for conservation. CI has identified Madagascar as a biodiversity hotspot, and it is also one of WWF's Global 200 ecoregions of importance. The protected areas within the Spiny Forest region include Andohahela National Park, Cap Sainte-Marie Special Reserve, Tsimanampetsotsa National Park, Beza Mahafaly Special Reserve and Berenty Private Reserve.

Africa and Madagascar (continued)

Threats – The main threats to the region include deforestation by slash-and-burn agriculture for cash and subsistence crops; supplying charcoal and fuelwood to urban markets for household cooking; uncontrolled cattle grazing and use of fire in pastoral systems; the loss of social norms and traditional taboos favorable to conservation; extraction and sale of wood for construction and for furniture production for regional and international markets; unsustainable collection of medicinal plants; and illegal trafficking of wildlife for sale in domestic and international markets. Economic and development policies and global markets are key factors underlying the changing environmental conditions of southern Madagascar (Minten 2006).

Driving Forces

Spiritual and cultural traditions run deep in Madagascar. The homeland where ancestors are buried is extremely important to the people of southern Madagascar, so migrants leaving their villages have every intention of returning within a few years, after they save money from working elsewhere. However, a growing number of migrants are no longer returning due to the difficulties in making an adequate living in their ancestral lands and their inability to save funds from their efforts in the settlement villages. The lack of enforcement of existing regulatory policies and international conventions, and corruption within the natural resources management and law enforcement agencies—both locally and nationally—facilitate the exploitation and transformation of natural resources in the settlement zones, often in conflict with the indigenous communities that live there.

Push Factors – Long-standing traditions based on the cultural importance of cattle drive men of the Tandroy and Mahafaly groups to migrate. Men leave their ancestral villages in search of funds to purchase cattle for cultural ceremonies such as the building of tombs for a deceased relative, pay bride-price, improve social status or resolve a social conflict. People migrate to survive natural and climatic factors, such as longer drought periods, decreasing soil fertility, invasive plants, locust invasions and cyclones. Demographic factors, such as population growth in areas where arable land is limited, cause many single men to migrate to seek a means to support those who remain in their home village. Migrants also originate from communities that are remote and without access to markets and social services, a situation often related to deteriorating road infrastructure.

Pull Factors – Destination factors that attract migrants include demand for labor in agriculture in cash (share) cropping systems, access to roads and hence urban markets for agricultural and forest products, small-scale mining opportunities and various opportunities to diversify sources of revenue. Migrants are attracted to specific settlement areas by family or village-level connections. The principal settlement zones are those where indigenous communities have yet to develop adequate social controls governing new settlements and unauthorized forest clearing. In these areas, migrants can often develop settlements without resistance. If cash crops are being grown for regional agribusinesses, there is often political backing for migrant settlements, and the indigenous communities have little power to resist.

Interventions

Some indigenous communities in the Spiny Forest region are beginning to develop adaptation strategies for dealing with migrants. In some cases, they develop controls and social norms governed by traditional decisionmaking groups to manage the activities of migrants and reduce their access to natural resources, such as restricting them to sharecropping. In other cases, the migrants are subjected to harassment and theft. And in others, the indigenous people prohibit migrants from living in their communities. An observed perverse effect happens when the indigenous communities adopt the techniques and practices of the migrant communities, such as shifting from subsistence to commercial agriculture and diversifying income-generating activities to include the transformation and sale of forest products. Though this perverse effect is unfortunate, the indigenous communities usually have better control over which resources are exploited. It is also easier for conservation programs and institutions to work with these communities than with migrants to promote wiser management of forest resources.

Influencing Migration – To encourage people to remain in their ancestral lands and make long-term investments in natural resource restoration, informal migration management projects are being implemented to reorient rural development programs and road rehabilitation projects to the high-profile areas of out-migration along the coastal zones. Given the high levels of rural development assistance that are earmarked for southern Madagascar, these regional policy orientations are already showing some positive results in some of the most degraded and climatically inhospitable areas of the south.

Reducing Impacts of Migrants (in destination area) – The NGO community has developed education and communications campaigns in an attempt to manage the

negative social and environmental impacts of migration. They also attempt to empower indigenous communities to seek the transfer of legal rights from the state for managing their land and natural resources. Additional programs encourage migrants to return to their ancestral lands in order to contribute to evolving economic and natural resource restoration programs. A policy mechanism that holds potential is the communal development plan, which provides guidelines for the exploitation of natural resources and investment of rural development funding. Likewise, NGOs are slowly working with authorities to ensure the transparent enforcement of existing forestry laws and to eliminate corruption in the court system (which has often resulted in the acquittal of those charged with illegal forestry activities). Finally, a program is evolving for developing alternative sources for cooking fuel and construction materials, particularly for large urban areas that rely on forest products produced by migrant labor.

Contacts

Mark Fenn (WWF);

Mark Freudenberger (Ecoregional Initiative, Fianaransoa, Madagascar);

Oliver Pierson (U.S. Forest Service);

Jennifer Talbot (former University of Michigan Population-Environment Fellow in Madagascar);

Adam Tomasek (WWF)

References

Fenn, M. & Rebara, F. Undated. *Present Migration Tendencies and Their Impacts in Madagascar's Spiny Forest Ecoregion.* Internal document. Madagascar: World Wildlife Fund.

Gelman, N.B., Oglethorpe, J. & Mauambeta, D. 2006. The impact of HIV/AIDS: How can it be anticipated and managed? *Parks* 15(1):13-24.

Minten, B. 2006. *Trade Liberalization, Rural Poverty and the Environment: The Case of Madagascar.* Madagascar: World Wildlife Fund.

(WWF) World Wildlife Fund Madagascar Program. Undated. *Present Migration Tendencies and Related Social and Environmental Impacts in Madagascar's Spiny Forest Ecoregion.* English language summary: Fenn, Koto, Robinson & Whynner. 1999. Les tendances actuelles de la migration des peoples et son impact dans la region ecologiques des forets epineuses a Madagascar. Madagascar: World Wildlife Fund.

WWF Madagascar and West Indian Ocean Regional Program. 2002. *Plan pour la conservation de la biodiversite des forests d'epineux de Madagascar.* Madagascar: World Wildlife Fund.

Vietnam
Greater Annamites Ecoregion

Demographics of Migration (including place of origin)

In recent years, people in Vietnam have become increasingly mobile and have more access to once-isolated parts of the country. They are moving both seasonally and permanently in growing numbers (Carew-Reid 2002). Movements occur from rural to urban areas and to regions of biodiversity wealth. In Quang Nam province, in the heart of the Central Annamite Mountains on the border with Laos, indigenous Mo'Nong, Ta Rieng and Ka Tu people have been overwhelmed by the in-migration of large numbers of legal and illegal miners (specifically in the Phuoc Son area). Conflicts have developed between these migrants and local indigenous populations whose livelihoods are being threatened. Much of the mining is around the Song Thanh Nature Reserve (Hardcastle, pers. comm. 2004). A total of 8 million people belonging to 37 ethnic minority groups live in the Central Annamites; 1,446,359 of them reside in Quang Nam province (*Quang Nam Statistical Yearbook* 2004).

Conservation Issues

Values – The Song Thanh Nature Reserve (STNR) is 95 percent forested. The tropical rain forest grows on the granite mountains of the Central Annamites. It contains at least 831 vascular plant species, of which 23 are endemic to Vietnam and 49 are listed as threatened or endangered. Mammals such as tigers, Asian elephants and gibbons inhabit the forests. Table 5 contrasts species numbers reported by the Vietnamese government (Forest Inventory 1999) with results of surveys conducted by WWF through the Management of Strategic Areas for Integrated Conservation (MOSAIC) project between 2002 and 2005 (Long *et al.* 2005).

Threats – Threats to the STNR include dam construction, slash-and-burn agriculture, fires, forest clearance, hunting, logging and poaching for the domestic and international wildlife trade. In addition, gold mining technology is altering river hydrology, and use of toxic chemicals is depleting fish stocks. The Central Annamites are also the site of the Ho Chi Minh Trail, where the Americans dropped millions of liters of Agent Orange and other resilient toxic defoliants during the Vietnam War. Fortunately, these toxins are not known to have contaminated the forests of the STNR.

Driving Forces

Push Factors – Since the late 1970s, state policy has encouraged isolated minority villages to move down from the high mountains to valleys and the vicinity of roads, markets and towns. Scattered settlements have been regrouped into larger village communities to enable sedentarization of the indigenous population. With the construction of the new Ho Chi Minh Highway linking Hanoi with Ho Chi Minh City (Saigon) and the East-West Economic Corridor resettlement and sedentarization, programs have received renewed attention and added

Table 5. Results of species inventory, Song Thanh Nature Reserve, Vietnam

Taxa	Investment plan total	Survey results	Vietnam Red Data Book*	IUCN Red Data Book 2002**
Mammals	53	29	14	10
Birds	183	154	12	2
Reptiles	44	22	11	2
Amphibians	21	12	4	0
Fish	-	10	0	0
Butterflies	-	106	0	0
Flora	831	329	17	2

*Ministry of Science, Technology and Environment. 2000. *Red Data Book of Vietnam*, volume 1, Animals. Hanoi, Vietnam: Science and Technics Publishing House; Ministry of Natural Resources and Environment and Vietnamese Academy of Science and Technology. In press. *Red Data Book of Vietnam*, Plants. Hanoi, Vietnam: Science and Technics Publishing House.

**C. Hilton-Taylor (Ed.) 2000. *2000 IUCN Red List of Threatened Species.* Gland, Switzerland, and Cambridge, UK: World Conservation Union.

urgency. Insufficient employment opportunities in areas of origin also motivate people to migrate.

Pull Factors – Gold mining is an important attraction in the rivers of the region. Migration to the area is facilitated by Ho Chi Minh Highway, which provides access for migrant traders who drive the need for forest clearance along the highway. Policy contradictions exist between provincial and national development and zoning plans. The uncertainties of land tenure cause migrants to join existing villages or camp in the forest. When migrants join an ethnically homogeneous village, they contribute to the erosion of traditional lifestyles. This attracts more pioneer settlers, traders and entrepreneurs of the majority ethnic group, the Kinh, into areas previously inhabited exclusively by indigenous people and ultimately leads to more forest clearing.

Interventions

Influencing Migration – Migration, land allocation and land tenure policies are under review, along with case studies on gold rush migration in the Phuoc Son area and impacts of the Ho Chi Minh Highway on upland indigenous culture from spontaneous and planned migration. In February 2004, the director of the Department of Natural Resources and Environment requested help on this issue. At the same time, the local government appealed to the National Assembly, and a flotilla of helicopters and army troops moved into the area to evict the miners. However, somehow the miners found out about this plan and left the area before the squadrons arrived, only to return at a later date. Gold miners continue to operate throughout Quang Nam and Song Thanh (Hardcastle, pers.comm. 2004). At the provincial level, authorities are doing everything they can to stem the illegal mining, but it has been very difficult to control; it seems the enforcement effort cannot be increased to a sufficient level to prevent the illegal mining. In mid-2005, approximately 400 miners were discovered within the STNR. The reserve has only 29 staff members, so it is challenging keeping people outside of the boundaries of the 93,249 hectare reserve.

Reducing Impacts of Migrants (in destination area) – The MOSAIC project is using participatory three-dimensional models to help villagers conceptualize relationships with their land and environment. The models also provoke discussion between villagers and authorities on topics that might be considered sensitive, such as illegal mining, forest zoning and access routes used by hunters and loggers. The allocation of forested land is ongoing, and village protection teams have been established to keep outsiders out of community forest areas. Rangers are receiving extensive law enforcement training and management support. Reserve management is engaged in management planning, including the initiation of monitoring mechanisms. In addition, several approaches are under consideration for reducing impacts, including a review of mining law, the establishment of economic zones for mining activity within the province, collaboration with mining companies that are operating legally within the area to promote low-impact mining practices and enforced restriction of mining activity in certain areas in and around the reserve.

Contacts

James Hardcastle (WWF, Vietnam Program);

Barney Long (WWF, MOSAIC project, Vietnam);

Valerie Hickey (World Bank)

References

Carew-Reid, J. 2002. Why the urgent need to study the links between protected areas and socio-economic development? Round table meeting discussions in Vietnam, Cambodia and Thailand. Online. Available: http://www.mekong-protected-areas.org/overview/overview.htm. April 7, 2004.

Forest Inventory and Planning Institute. 1999. *Investment Plan for Song Thanh Nature Reserve.* Hanoi, Vietnam: Forest Inventory and Planning Institute. (In Vietnamese)

Hardcastle, J. 2004. Personal Communication. WWF Vietnam program development coordinator. April 12.

Long, B., Hoang, M. & Truyen, T. 2005. *A Conservation Assessment of Quang Nam Province, Central Vietnam.* WWF Vietnam, Tam Ky, Vietnam.

Quang Nam Statistical Year Book. 2004. Hanoi, Vietnam: Quang Nam Statistical Publishing House.

(WWF) World Wildlife Fund Vietnam Program. 1999. *Human Migration and Resource Utilization: A Research Project of Population Dynamics and Resource Utilization in the Buffer Zone of Yodon National Park and the Surrounding Region Daklak Province.* Hanoi, Vietnam: WWF Vietnam Program.

Notes – The moist forests of the Central Annamite Mountains are one of WWF's Global 200 ecoregions. Through the MOSAIC project, WWF is working with local villagers and forest officials to design and implement sustainable management practices. WWF is aware of the serious migration issue in this region and is working toward the collection of solid data on the scope, scale and impacts.

Nepal
Part of the Terai Arc

Demographics of Migration (including place of origin)

The Terai Arc landscape includes 11 transboundary protected areas in Nepal and India. The Nepal side of the landscape is home to 6.7 million people. Although the Terai constitutes only 23 percent of the total land area of Nepal, 47 percent of the population now inhabits this region. Following the malaria eradication program in the Terai in the 1950s, people began to migrate toward the lowland Terai region from the hills north of the Terai. High rates of migration to the Terai make the overall population growth rate much higher in this region than in the country as a whole (Chhetri 2001). According to census data, a 47.9 percent increase was attributed to migration in the Terai from 1981 to 1991 (Khatri-Chhetri & Devkota 2003).

Conservation Issues

Values – The Terai Arc is listed as a WWF Global 200 ecoregion. It covers approximately 49,500 square kilometers of dense forests and tall grasslands below the southern slope of the Himalayas. It is one of three regions with the highest tiger (*Panthera tigris*) density in Asia, contains the second largest population of greater one-horned rhinoceros (*Rhinoceros unicornis*) in the world and has six isolated populations of Asian elephants (*Elephas maximus*). In Nepal, the Terai Arc includes four protected areas—Chitwan National Park, Parsa Wildlife Reserve, Bardia National Park and Suklaphanta Wildlife Reserve—while in India it includes seven national parks and wildlife sanctuaries.

Threats – The main threats to protected areas in the Terai are habitat destruction and fragmentation resulting from conversion of forested land for agriculture. The Terai Arc is an important center for rice production in Nepal. Agricultural conversion is also taking place in national forests, increasing fragmentation and loss of habitat connectivity for large mammal species such as the rhino and the tiger. Among the underlying drivers of these threats are increasing population growth and a failing land tenure system with absentee landlords.

Driving Forces

Push Factors – These include shortage of land, high population growth and lack of employment opportunities in the hills north of the Terai.

Pull Factors – Previously, migrants were drawn to the region by government resettlement policies. Now people migrate to improve living conditions and take advantage of unprotected national lands covered in forests with good soils for farming. Migrants are also drawn by infrastructure developments, including new roads, availability of schools, hospitals and clinics, and service-related economic opportunities.

Interventions

Influencing Migration – A long-term strategy is needed because migrants tend to return quickly if they are moved out. The Department of Forests (DOF) currently razes illegal settlements, but migrants return quickly. Before the Maoist insurgency forced conservation practitioners to put talks on hold, another strategy under discussion was the use of urban development plans to create magnets that could attract migrants away from especially fragile core areas (Chungyalpa, pers. comm. 2004).

Reducing Impacts of Migration (in destination area) – To address the issues of land conversion and encroachment, especially in forested areas, the WWF Terai Arc Landscape (TAL) program has proposed (1) the removal or eviction of encroachers with the participation of local communities, (2) the promotion of community forestry to enable communities to protect their own resources through various activities and (3) promotion of off-farm income generation with minimal focus on agriculture (WWF Nepal Program 2004a). It is also important to strengthen the land tenure of indigenous forest users located inside the invaded areas to help them protect the land and resources from the destructive influence of outsiders. WWF is currently working with a number of partners, including CARE Nepal, to go beyond the classic ICDP approach to integrate agriculture, community forest management, health care, girls' education, research and planning, while focusing on forest landscape restoration (WWF Nepal Program 2004b).

Contacts

Dekila Chungyalpa (WWF);

Anil Manandhar (WWF, Nepal Program)

References

Chhetri, R.B. 2001. *A Socioeconomic Situation Analysis of the Terai Arc Landscape: Local Level Perspectives From the Three Bottleneck Areas.* Nepal: Tribhuvan University.

Chungyalpa, D. 2004. Personal Communication. Priority leader, Mekong Basin, World Wildlife Fund. June 14.

Khatri-Chhetri, J. & Devkota, M. 2003. *Socioeconomic Study of Terai Arc Landscape Area.* Ekantakuna, Lalitpur, Nepal: Institute for Social and Gender Equality.

(WWF) World Wildlife Fund, Nepal Program. 2004a. *Terms of Reference for Assessing Land Conversion and Land Encroachment in TAL and Migration Assessment as a Case Study in a Site in TAL.* Internal document. Washington, DC: World Wildlife Fund.

WWF Nepal Program. 2004b. *Terai Arc Landscape.* Internal document. Washington, DC: World Wildlife Fund.

Cambodia
Central Cardamom Protected Forest

Demographics of Migration (including place of origin)

In Cambodia, rural-to-rural migration is the most common form of migration, constituting about 70 percent of the total (National Institute of Statistics 2005). Before 1997, the annual population growth rate in the south-western part of Cambodia immediately south of the Central Cardamom Protected Forest (CCPF) was estimated to be just less than 3 percent. Currently in the provinces of Sihanoukville and Koh Kong, where the CCPF and other parks are located, roughly half of the population is migrants, more than half of whom have arrived in recent years (PAD Partnership 2003). According to a study done by CI in 2002, the population in the Thma Bang and Tatai Leu areas of the CCPF includes former or current military families and civilians displaced by the war with official permission to relocate, former logging workers and some "old" people whose families have resided in the region for many generations. Today the population includes Khmers, who have been in the border camps for many years; temporary migrants from nearby locations involved in illegal activities inside the park, such as timber extraction and trade in wild animals; and perhaps some Thai refugees coming from camps in the northwest with semiofficial approval to relocate (Peters, pers comm. 2004). Some of the families, both military and local, have sold their land to wealthy property developers and left the area in recent years.

Conservation Issues

Values – The Cardamom Mountains are one of the largest, most pristine areas in mainland Southeast Asia. They cover 6 percent of Cambodia and shelter most of the country's large mammal species and half of its species of birds, reptiles and amphibians. The mountains provide critical habitat for the region's rare animals, including the globally threatened Asian elephant (*Elephas maximus*), Malayan sun bear (*Helarctos malayanus*) and pileated gibbon (*Hylobates pileatus*), as well as one of the last known wild breeding populations of Siamese crocodiles (*Crocodylus siamensis*). Many of Cambodia's largest rivers flow down from the slopes of the Cardamoms, forming an important watershed. Deforestation here could lead to silting of rivers in major rice-growing areas and fisheries and exacerbate flooding downstream.

Asia (continued)

Threats – In the CCPF region, threats include hunting and wildlife trade in animal skins and body parts; population growth, primarily from in-migration; clearing of land for agriculture, rice and cash crops; and collection of forest products for food, fuel and house construction (very low threat). Other prominent threats include hydro-development and mineral exploration and exploitation; land grabbing by powerful outsiders, inside both the CCPF and buffer zones; and illegal logging by military and armed forces.

Driving Forces

Push Factors – In lowland areas, population growth has stimulated an increase in the clearing of land for planting agricultural crops, such as rice. There has been considerable loss of forest cover in the "rice belt" provinces for generations; however additional loss means a decrease in forest products for food, fuel and wood, which families rely on to make ends meet, especially in hard times. This situation creates economic migration toward the highland areas, driving migrants away from the more resource-poor, highly populated provinces in the lowlands. Additionally, there has been some government-sponsored resettlement into rural areas (and sometimes protected areas), particularly of demobilized members of the country's armed forces, such as the Khmer Rouge and other militia, mostly in the 1990s.

Pull Factors – The main attraction is the availability of land in highland areas, especially around protected areas where migrants think there is access to free natural resources. Although all logging concessions have been suspended, jobs are available in illegal logging and other kinds of economic concessions, such as plantations. In some parts of the CCPF (specifically the Areng Valley), Vietnamese forces displaced people during the civil war and ensuing instability. Many of the originally displaced families have since moved back to their homelands and resettled on their own. Route 48, which stretches from Phnom Penh to the town of Koh Kong, on the border with Thailand, is undergoing substantial renovation with funding from a variety of sources, including the Thai government. This newly renovated road is already providing easier access for migrants and is expected to facilitate an increase in the pace of forest resource exploitation. It is part of an ambitious economic development corridor supported by the Asian Development Bank (ADB).

Interventions

Influencing Migration (away from the CCPF) – CI has been working with the Forestry Administration (FA) since March 2001 to improve law enforcement and build ranger capacity in the CCPF and surrounding areas. This has proved to be one of the biggest challenges to achieving effective conservation management (Claridge *et al.* 2005). In 2002, CI and the FA negotiated the relocation of a battalion of 400 soldiers and their families away from the CCPF. WildAid has been managing a voluntary resettlement project to provide forest-dwelling families in Chi Phat with the opportunity to live in a new town located on the highway, where they can grow cash crops away from areas of biological importance.

Reducing Impacts of Migration (in destination area) – With funding from USAID, CI has led a participatory land-use planning process that has been successful in clarifying land and user rights and creating local institutions. The process has resulted in the production of maps of three communes, designating community lands, forest estate and other land-use categories (Milne, pers comm. 2005). CI and CARE Cambodia are working with commune residents in the Thma Bang District of CCPF to provide better access to health and education services and to improve livelihoods, while increasing awareness of environmental conservation and the importance of a healthy environment.

Contacts

Sarah Milne (formerly CI);

Jim Peters (formerly CI);

Jake Brunner (CI);

Wayne McCallum (CI);

Bunra Seng (CI)

References

Claridge, G., Chea-Leth, V. & Chhaon V. 2005. *The Effectiveness of Law Enforcement Against Forest and Wildlife Crime: A Study of Enforcement Disincentives and Other Relevant Factors in Southwestern Cambodia.* Honolulu, Hawaii: East-West Management Institute.

(CI) Conservation International. 2002. *Report on Village Surveys in the Thma Bang and Tatai Leu Areas, December 2002, Central Cardamoms Protected Forest (CCPF).* Internal draft report. Phnom Penh, Cambodia: Conservation International Cambodia Program.

Milne, S. 2005. Personal Communication. Community program manager, CI Cambodia Program. May 13.

National Institute of Statistics. 2005. *Cambodia Intercensal Population Survey 2004. Spatial Distribution and Migratory Movements.* Report 5. Phnom Penh, Cambodia: Ministry of Planning.

PAD Partnership. 2003. *Cambodia: National Report on Protected Areas and Development. Review of Protected Areas and Development in the Four Countries of the Lower Mekong River Region.* Queensland, Australia: International Centre for Environmental Management.

Peters, J. 2004. Personal Communication. CI senior advisor for stewardship and governance. April 16.

Latin America

Brazil
Atlantic Forest

Demographics of Migration (including place of origin)

In Brazil, migration to rural, forested frontier areas has occurred on a large scale. Approximately 50 million people migrated to rural areas, especially the vast Amazon, between 1950 and 2000 (Sawyer & Rigotti 2001). Today more than two-thirds of the Brazilian population lives around the Atlantic Forest region. From 1996 to 2000, the population in this region grew at a rate of 1.8 percent per year, above the national average of 1.5 percent (Jacobsen 2003). Average family size in communities near the Una Biological Reserve was estimated at seven in the late 1990s (Jupara 1998). Migration to the southern part of the state of Bahia, where conservationists are trying to protect remnants of the Atlantic rain forest, is internal to the region, primarily from impoverished rural and urban areas to rural, forested areas where resources are more abundant.

Conservation Issues

Values – The isolation of the Atlantic Forest from the Amazon and Andean regions has led to the evolution of unique and extremely diverse biota, with numerous endemic species. CI has identified the Atlantic Forest as a biodiversity hotspot, and it is on the WWF list of Global 200 ecosystems. The original tract of Atlantic Forest extends from Argentina to Paraguay to the northeastern Brazilian state of Pernambuco. Today, a portion of the moist forests along the northeastern coastal section of the Atlantic Forest is found in southern Bahia. However, only 3 percent of the original Atlantic Forest in southern Bahia currently exists, and much of it is held together by cacao plantations (WWF-Brazil 2003). The largest remnants are near the coast in areas with the poorest soils (Alger 2003). Very high plant species richness has been documented near the Una Reserve in Bahia: 454 tree species per hectare (Aguiar *et al.* 2003). It is also very high in bird diversity, and endemic mammal species include the golden-headed lion tamarin (*Leontopithecus chrysomelas*) (Kierulff *et al.* 2003).

Threats – The main threats continue to be road construction; clearing (or burning) of forests for agricultural use, including cacao and coffee farming, pasture for cattle grazing, sugarcane plantations and monoculture reforestation with eucalyptus; illegal and unsustainable logging; fuelwood harvesting; plant and animal poaching and subsistence hunting; introduction of alien species; urban expansion and industrialization; and tourism expansion. Land reform movements bring settlers and squatters to forested areas.

Driving Forces (origin, within region)

Migration is primarily internal to the region, as the rural and urban poor seek out rural areas for farming and other subsistence-level activities.

Push Factors – Push factors include urban violence, especially against women; unhealthy, polluted urban environments; a drop in the price of cacao (due to an increase in production of cacao on the world market, which caused prices to drop and created widespread unemployment on Brazilian cacao farms); lack of alternative economic opportunities, especially in the *favelas*, or shantytowns, surrounding rural towns in the cacao region; and lack of land in areas of origin.

Pull Factors – Political land reform movements have served to attract migrants. For example, squatter groups of unemployed farm workers supported by human rights groups, the Catholic church, rural farm workers' unions and land reform groups such as the *Movimento dos Trabalhadores Rurais Sem Terra* (MST) seek to expropriate farms (or portions of farms, usually the "unproductive" forested land) and create recognition of these areas as land reform communities. In exchange for votes, political activists and unscrupulous land brokers promise land (usually the unoccupied, "unproductive" forested land) and social services to the landless poor—displaced rural workers, historically exploited sharecroppers and urban dwellers. The federal land reform agency, Instituto Nacional de Colonização e Reforma Agrária (INCRA), is under political pressure to settle as many families as possible at the lowest possible cost to remove land reform as an election issue. Relocation is easier to do in unoccupied forested areas than confronting armed farm owners on cacao farms (Alger 2003). Additionally, national law and public policy encourage squatters to settle in forested areas because the courts have traditionally viewed standing forest as unproductive, unoccupied and therefore available. Technically, forested land is protected by law, but once use rights have been awarded, the federal environmental agency considers the forest on that land to be outside its responsibility. Brazilian judicial practice favors awarding titles to people who pay taxes on land. Because multiple titles often exist for the same piece of land, land that has no clear title can be regarded as available. Lack of land reform, especially in less-contested forested fragments on the coast, also acts as a pull factor.

Interventions

Influencing Migration – One recommended intervention is to work with government and landless people to identify areas where the establishment of settlements would have less impact on the environment. Information campaigns in areas of origin would discourage migrants from settling in forested lands, where soils are usually sandy, of low quality and not good for agriculture. This should be done by working closely with land reform movements, such as MST. Improved use of zoning and land-use planning is critical, as is updating the law that establishes productivity indices.

Reducing Impacts (in destination area) – After areas have been selected for settlement, many conservation practitioners advocate a participatory planning phase that considers the area as part of a larger landscape. Conservation corridors need to be created to link smaller forest fragments with larger ones, based on landscape planning and geographic zoning. The Forest Code of 1965 requires that farms maintain 20 percent of their land area in natural forest reserves. Once use rights have been awarded to expropriated land, INCRA subdivides the land checkerboard-style, requiring that each lot have a forest reserve. For example, the modular lot size for the cacao region is 20 hectares, so that a confiscated 1,000-hectare farm with 400 hectares of natural forest reserve is subdivided into 50 lots, each with 4 hectares of forest reserve (Alger 2003). Participatory planning in collaboration with local communities and small farmers to unify forest reserves and create wildlife corridors is an important strategy for reducing impacts and preserving forest fragments (Cullen *et al.* 2005). Other proposed programs include public health, family planning and women's empowerment programs, linked to programs of community-based agriculture; agroecology and sustainable development; agroforestry, including organic agriculture; community and organizational capacity building; product marketing; and environmental education. Improved enforcement of existing laws regarding deforestation in the Atlantic rain forest region is also crucial.

Contacts

Keith Alger (CI);

Helena Maltez (WWF Brazil Program);

Bob Buschbacher (formerly WWF, Brazil Program, currently with the University of Florida)

References

Aguiar, A.P., Chiarello, A.G., Mendes, S.L. & de Matos, E.N. 2003. The central and Serra do Mar corridors in the Brazilian Atlantic Forest. In C. Galindo-Leal & I. de Gusmao Camara (Eds.), *The Atlantic Forest of South America: Biodiversity Status, Threats and Outlook.* Pg.118-132. Washington, DC: Island Press.

Alger, K. 2003. The reproduction of the cocoa industry and biodiversity in southern Bahia, Brazil. Smithsonian Migratory Bird Center. Smithsonian National Zoological Park. Online. Available: http://nationalzoo.si.edu. October 1, 2004.

Cullen Jr., L., Alger, K. & Rambaldi, D.M. 2005. Land reform and biodiversity conservation in Brazil in the 1990s: Conflict and the articulation of mutual interests. *Conservation Biology* 19(3): 747–755.

Jacobson, T.R. 2003. Populating the environment: Human growth, density, and migration in the Atlantic Forest. In C. Galindo-Leal & I. de Gusmao Camara (Eds.), *The Atlantic Forest of South America: Biodiversity Status, Threats and Outlook.* Pg.426-435. Washington, DC: Island Press.

Jupara. 1998. *Health, Environment and Women's Empowerment in the Region of Southern Bahia, Brazil.* Project proposal. In proceedings of Population-Environment Fellows Workshop. March 30 – April 3, 1998. Ilheus, Brazil. Ann Arbor, MI: Population-Environment Fellows Program, University of Michigan.

Kierulff, M.C.M., Rambaldi, D.M. & Kleiman, D.G. 2003. Past, present, and future of the golden lion tamarin and its habitat. In C. Galindo-Leal & I. de Gusmao Camara (Eds.), *The Atlantic Forest of South America: Biodiversity Status, Threats and Outlook.* Pg. 95-102. Washington, DC: Island Press.

Rocha, R., Alger, K., Reid, J., Loureiro, W., Horlando, H. & Villanueva, P. 2004. *Conservacao das florestas e politicas publicas – a experiencia do sul da Bahia.* Internal report. Washington, DC: Conservation International.

Sawyer, D. & Rigotti, J.I.R. 2001. *Migration and Spatial Distribution of Rural Population in Brazil, 1950–2050.* Presented at the XXIV General Population Conference, International Union for the Scientific Study of Population. August 18–24, Salvador, Bahia, Brazil.

(WWF) World Wildlife Fund, Brazil Program. 2003. *O movimento agroecologico do sul de Bahia: un modelo de agricultura familiar na reforma agraria visando a conservacao da Mata Atlantica.* Internal report. Brasilia, Brazil: WWF Brazil Program.

Colombia National Parks

Demographics of Migration (including place of origin)

The Colombian National Drug Agency has regulated the large-scale aerial application of herbicides in national parks to control coca and poppy cultivation, even though it is illegal to fumigate public protected areas in Colombia. Given that 800,000 people currently live inside Colombia's protected areas, there is much concern that aerial spraying may push people deeper into the jungle to more remote and fragile parts of the parks. It may also act as a deterrent for people who want to cultivate nondrug crops on the edge of park boundaries because the spray may carry over to non-target vegetation. The complexity of the situation is intensified by the fact that in many cases, the drug-related crops are being cultivated by individuals who are settled illegally inside Colombia's protected areas (Ministerio de Ambiente 2005). Currently, three parks are threatened by fumigation: Sierra Nevada de Santa Marta, La Macarena and Catatumbo.

Conservation Issues

Values – The parks are fragile tropical ecosystems, home to many endangered and endemic species. Because of its location and variety of ecosystems, Colombia is considered to be among the world's top five countries for biodiversity. Despite a lack of scientific research and incomplete inventories of flora and fauna, Colombia ranks first in species of birds and amphibians, second in vascular plants and third in mammals worldwide. In the Sierra Nevada, 628 bird species have been recorded, and many of these, such as the Santa Marta parakeet (*Pyrrhura viridicata*) and the white-tailed starfrontlet (*Coeligena phalerata*), are endemic.

Threats – The primary threat is increased deforestation from migrants moving deeper into forested areas due to the application of the nonselective herbicide, glyphosate, which has potential to kill or stunt the growth of many plants and trees. Spray drift, with or without wind, causes substantial damage to non-target vegetation. The loss of vegetation and effects of spray drift may have cumulative impacts on fragile ecosystems, habitat and endemic species. According to Marsh (2004), previous risk assessments of the herbicidal glyphosate formulation have not been specific to Colombia or the tropics.

Driving Forces

Push Factors – Plan Colombia, a drug control policy funded by the United States to eradicate coca and opium poppy, has facilitated aerial fumigation in Colombia by the National Drug Agency since 2003. The fumigation of drug-related crops, and indirectly of food crops, human beings and wildlife, has caused the displacement of rural communities in the southern Colombian Amazon. It may also cause the relocation of coca fields to more remote areas deeper inside the jungle, resulting in further deforestation. The cultivation of drug-related crops has often increased in adjacent provinces after fumigation takes place, which suggests that instead of eliminating drug-related crop cultivation, fumigation may result in the translocation of cultivation to other areas. Pressures from militant groups such as the Revolutionary Armed Forces of Colombia (FARC) and paramilitary groups may also result in relocation of rural communities.

Pull Factors – Rural campesino and indigenous populations, both elsewhere in Colombia and within the Amazon region, may seek to move to national park areas, particularly those in the Colombian Amazon that are especially remote, to avoid the effects of fumigation of food crops. International markets, primarily in the United States and Europe, generate the demand for the illicit substances derived from the coca and opium poppy.

Interventions

Influencing Migration – A suggested strategy would be to provide short-term aid, including food, to farmers in the region who lose their crops as a result of spraying. In the Social Eradication Pacts program implemented by USAID, participants are given up to 1 year to manually eradicate coca plants in exchange for food aid. The program stipulates that if the plants are removed within 1 year, aerial spraying can be avoided. However, this plan has in many instances failed. Food aid often doesn't arrive; and in some cases, despite the fact that coca plants are successfully eradicated manually, spraying occurs anyway (Marsh 2004).

Reducing Impacts of Migration (in destination area) – Some form of short-term aid could be provided to farmers who lose their food crops and cash crops as a result of the spraying. Although it is conceivable that the civil war in Colombia is protecting the forest by discouraging further road construction, oil exploration and deforestation, measures such as the aerial application of herbicide used to combat the cultivation of drug-related crops that help finance the rebel faction may have long-term effects on the tropical forest biota.

Contacts

Pilar Barrera (TNC, Colombia/Venezuela Program);

Jerry Touval (TNC)

References

Marsh, B. 2004. *Going to Extremes: The U.S.-Funded Aerial Eradication Program in Colombia.* Washington, DC: Latin America Working Group Education Fund.

Ministerio de Ambiente, Vivienda y Desarrollo Territorial: Unidad Administrativa Especial del Sistema de Parques Nacionales Naturales de Colombia. 2005. *Estrategia integral y diferencial para el manejo de los asentamientos y usos ilícitos en áreas del Sistema de Parques Nacionales Naturales y sus áreas amortiguadoras.* Internal document. Bogotá, Colombia.

Ecuador
Galapagos Islands

Demographics of Migration (including place of origin)

The Galapagos have experienced rapid population growth from 1974 through 1997 (6 percent per year). Less than half of the growth, about 2.5 percent, was due to net migration. In 1998 the Special Law for the Conservation and Sustainable Use of the Galapagos Province was enacted. Kerr *et al.* (2004) calculated a population growth rate of 5 percent for 1998 through 2001, which suggests a slight slowing in the growth rate from earlier years. However, earlier estimates varied in the way they dealt with the transient population, and thus the actual migration rate before the enactment of the legislation may have been between 5 and 6 percent annually. This implies that passage of the Special Law probably had little or no impact on reducing migration from 1998 to 2001 (Bremner, pers. comm. 2006). The vast majority of the migrants to the Galapagos come from mainland Ecuador, especially the provinces of Guayas and Pichincha (Fundación Natura, Ecuador 2000).

Conservation Issues

Values – The Galapagos comprise 13 large islands, 6 small ones, and 107 islets and rocks, with a total land area of about 8,000 square kilometers. The islands are volcanic in origin, and several volcanoes in the west of the archipelago are still active. The islands are home to many endemic animals, including the giant tortoise, which has evolved into 14 distinct forms on the different islands of the archipelago. There are also 13 species of finches, known as Darwin's finches, that have developed special adaptations to different foods; endemic sea birds, including a flightless cormorant (*Nannopterum harrisi*); the only penguin species that lives in tropical waters (*Spheniscus mendiculus*); the waved albatross (*Diomedea irrorata*); and the great (*Fregata minor*) and magnificent frigatebird (*Fregata magnificens*). Equally important is the diverse marine life inhabiting the waters surrounding the islands. Species such as the sea cucumber (*Isosthichopus fuscus*) are threatened by overfishing and other economic activity.

In 1959, Ecuador designated 97 percent of the land area of the Galapagos as a national park, and in 1986, the Galapagos Marine Resources Reserve was established to protect the waters around the archipelago. Legal protection in support of conservation and sustainable development in the Galapagos, including the marine reserve, was provided in

1998 with passage of the Special Law (Fundación Natura, Ecuador 2000).

Threats – There are multiple threats to the Galapagos Islands. According to a strategic analysis conducted by WWF, tourism, along with the migration and introduction of non-native species that often follow, is the greatest threat to the Galapagos (Spurrier, pers. comm. 2006). Among the introduced plant and animal species that threaten native species are guava (*Psidium guayaba*), blackberry (*Rubus niveus*), and numerous feral goats, cats, dogs and pigs. Additional threats include overexploitation of natural resources for both local population consumption and trade; unsustainable agricultural and fishing practices, such as longlining and marine mammal bycatch; illegal fishing of prohibited and commercial species; extraction of gravel and lime for construction and road building; population growth and urbanization, along with the water, soil and construction materials to support it; water pollution, soil contamination and generation of waste; increasing numbers of roads and vehicles, fostered by fuel subsidies; increased demands of the tourism industry; and lack of administrative capacity to enforce the Special Law.

Driving Forces

Push Factors – The key factors driving those who leave the mainland and migrate to the Galapagos are poverty and lack of economic opportunity. The Ecuadorian economy has grown very little since the early 1980s, which has led to massive international emigration as well as internal migration in search of a higher standard of living.

Pull Factors – Important factors attracting migrants include fishing opportunities (especially during the boom years for sea cucumber and lobster); opportunities through tourism; availability of land for agriculture, as well as increasing local markets resulting from population growth; employment opportunities in construction and transportation/tourism; the presence of family members or friends; and lack of enforcement of restrictions and regulations in the fishing and tourism industries. Also attracting migrants is the reduced cost of living resulting from government-subsidized energy/electricity, airfares for Ecuadorians (who pay only a third the fares of international tourists coming from the mainland), and shipping for food and other goods. Tourist companies benefit from these subsidies as well.

Interventions

Influencing Migration – Following realization of the increasing damage to the Galapagos from high in-migration, population growth and illegal activities, the Special Law was passed in 1998, establishing procedures for registration of all movement into and out of the islands. This law has been only partially enforced due to difficulties associated with the prominence of family networks, inequitable administration of policies (even local politicians and police have friends and family who reside in the islands illegally), and the complexity and cost of deportation from the islands to the mainland (Bremner, pers. comm. 2006). Existing laws and regulations need to be strictly enforced, especially those related to the Special Law and the infrastructure it creates. Other recommendations include development and enforcement of policies that (1) directly control migration and reduce the demand for labor through increasing efficiency, (2) reduce government subsidies that decrease the cost of living and hence attract migrants and (3) improve enforcement of labor regulations in the tourism and fishing sectors to decrease labor opportunities for new migrants and stabilize the existing labor force. Some capacity to enforce existing laws and regulations exists but needs strengthening (Kerr *et al.* 2004).

Reducing Impacts of Migration (in destination area) – Currently, all nonresidents of the Galapagos are required to pay a fee upon entering the islands; non-Ecuadorians pay a higher fee than Ecuadorians. All of the funds generated through this system stay in the Galapagos and are used for conservation, social services and infrastructure projects (Bremner, pers. comm. 2006). This system could be improved by requiring temporary residents and tourists to pay the estimated environmental and social costs of their stay on the islands, instead of the flat fee they currently pay that does not vary with duration of stay.

Contacts

Jason Bremner (Doctoral candidate, University of North Carolina);

Lauren Spurrier (WWF)

References

Bremner, J. 2006. Personal Communication. Doctoral candidate, University of North Carolina. August 22.

Fundacion Natura, Ecuador & The Nature Conservancy. 2000. *Parque Nacional Galápagos: Dinámicas migratorias y sus efectos en el uso de los recursos naturales.* Quito, Ecuador: The Nature Conservancy.

Kerr, S., Cardenas S. & Hendy J. 2004. *Migration and the Environment in the Galapagos: An Analysis of Economic and Policy Incentives Driving Migration, Potential Impacts From Migration Control, and Potential Policies to*

Reduce Migration Pressure. Motu Working Paper 03-17. Wellington, New Zealand: Motu Economic and Public Policy Research.

Spurrier, L. 2006. Personal Communication. Managing director for the Galapagos Department, World Wildlife Fund. June 2.

Mexico
Lacandón Forest

Demographics of Migration (including place of origin)

The Lacandón Forest of southern Mexico covers 454,860 hectares of land in the state of Chiapas and consists of 8 different protected areas (Nations 2006). In 2004, there were an estimated 25 unofficial population settlements in the Montes Azules Biosphere Reserve at the heart of the Lacandón Forest. The activities of the roughly 700 inhabitants of these settlements affect not only the protected area of the Montes Azules but also the lands and forests of the nearby Naha Flora and Fauna Protected Area and the Lacantún Biosphere Reserve. After civil unrest began in 1994, generated by the Zapatista movement and fueled by a lack of experience managing social conflicts of this type, many indigenous and poverty-stricken *campesinos*, mainly from Chiapas, fled into these forests to occupy land in a climate of lawlessness (Nations, pers.comm. 2005). Others from more distant regions arrived to take advantage of the social conflict to acquire lands without fear of government reprisal. In many cases, the opportunism of these migrants was rewarded with the relative tranquility of the remote forest region. While some of the communities were later removed, many were not. Since that time, the number of settlements has more than doubled.

Conservation Issues

Values – According to some estimates, the forested area of the Lacandón inside and around the protected areas has diminished by as much as 40 percent since the early 1990s. At this rate, it may be completely gone by 2015. It is a region of rich biodiversity, comprising tropical and montane rain forests, cloud forest, semideciduous tropical forest, savanna, pine-oak forest, seasonally flooded forest, gallery forest and open wetlands. There are more than 4,000 species of vascular plants, with high endemism and a number of threatened species. Montes Azules houses 28 percent of Mexico's mammal species, 32 percent of its bird species, 14 percent of its freshwater fish and 12 percent of its reptiles.

Threats – The main threats to the Lacandón Forest are subsistence agriculture, cattle grazing, illegal extraction of timber, hunting and fires for clearing vegetation for agriculture. In the past few years, new roads have been constructed, facilitating access to the forest. Intensive oil exploration has occurred in the region, and some wells have already been installed; however, the oil in this region is

considered to be of low quality and has not been prioritized for extraction. If priorities change and oil extraction does occur in this region, extraction with low environmental security standards could become a real threat.

Driving Forces

Push Factors – The critical and historical poverty and marginalization of the indigenous peoples of Chiapas has been the primary driving force pushing people into the forested areas of the region over time. In the 1990s, these conditions resulted in the Zapatista uprising and the subsequent civil unrest. The response of the Mexican military and local paramilitary groups caused people to flee into the forests. Many were landless when the conflict began. Others were ousted from their lands by paramilitary groups and had no choice but to go in search of new land. On a national level, land reform has been ineffective or incomplete (since the revolution began around 1920). Confused land-registry laws also contribute to the problem.

Pull Factors – Some migrants arrived in the region during the civil unrest of the 1990s to take advantage of the social conflict and acquire lands without fear of government reprisal. Others, especially those fleeing civil unrest in other parts of the country, are attracted by the relative tranquility of more remote areas within the forest. It can be difficult for military and paramilitary groups to access these areas, so they provide refuge for those escaping persecution. Park authorities lack the capacity or infrastructure to enforce regulations and maintain respect for laws and regulations.

Interventions

Influencing Migration – Poverty mitigation, as well as improving schools and education, is important in this region. Proposed strategies include requesting support for reinforcement of park infrastructure from federal and state governments to protect ecologically sensitive areas from encroachment. Another strategy is to physically delineate the different management zones of Montes Azules and other protected areas with some kind of markers, so people know where the boundaries of the protected areas lie.

Reducing Impacts of Migration (in destination area) – The federal government, through the Ministry of Agrarian Reform, is beginning to resettle some communities. This process is politically delicate due to sensitivities regarding land and indigenous rights, heightened by the Zapatista movement and made more complex by the fact that some of these communities may house central Zapatista figures. When resettlement takes place, measures need to be taken to avoid reinvasion of these areas by the original inhabitants or new migrants. This situation occurred in the neighboring state of Campeche after communities established within the Calakmul Biosphere Reserve were relocated in the mid-1990s. Proposed strategies include (1) increasing awareness among the population of the Lacandón Forest and in the country at large of the importance of reducing threats to protected areas, (2) involving the academic community and civil society in negotiating a solution with the inhabitants of the settlements that are currently located inside the protected areas, (3) filing lawsuits against current inhabitants to persuade them to leave and (4) expropriating the land from current inhabitants.

Contacts

CI Mexico Program;

Jim Nations (formally with CI, now with the National Parks Conservation Association [NPCA])

References

Nations, J.D. 2005. Personal Communication. Vice president for State of the Parks, National Parks Conservation Association. July 7.

Nations, J.D. 2006. *The Maya Tropical Forest: People, Parks, and Ancient Cities.* Austin, TX: University of Texas Press.

CI Mexico Program. 2002. Evaluación de afectaciones e impactos causados por las invasiones y ocupaciones irregulares a las áreas naturales protegidas de la Selva Lacandona de Chiapas (1994-2002). Powerpoint presentation. Online. Available: http://www.ci-mexico.org.mx/invasion1.html. April 16, 2004.

Guatemala
Maya Biosphere Reserve

Demographics of Migration (including place of origin)

Rapid in-migration to the Peten in northern Guatemala in the past few decades has led to the development of numerous multiethnic communities of people with a range of demographic characteristics and personal histories. According to a special Demographic and Health Survey (DHS) conducted in the region in 1999, the majority of residents in the region are migrants. Ladinos (Spanish speakers of mixed ancestry) from eastern and southern Guatemala make up 58 percent of the migrant population, and indigenous groups of Mayan ancestry make up a little less than 20 percent (Grandia *et al.* 2001). Many of the indigenous are Q'eqchi' people from the area north and northeast of the *altiplano* hills, where Guatemala City is located. Historically, there were several waves of migration to the Peten (Carr 2004, Margoluis 2004, Grandia, 2006). The earliest wave took place in the 1880s and was related to population displacement in southern Guatemala when Spanish settlers began seizing lands suitable for coffee plantations. Many Q'eqchi' families left Alta Verapaz to avoid the Spanish authorities and evade forced labor conscriptions (Secaira 1992). Another wave occurred in the 1930s and 1940s in response to vagrancy laws and forced labor under the Ubico regime. A third wave took place from the 1960s to the 1980s in response to opportunities presented through colonization programs and later in response to civil war.

Conservation Issues

Values – The Maya Biosphere Reserve covers 1.6 million hectares, or 15 percent of Guatemala's total land area. It contains 8 protected areas, with numerous threatened and endangered species, such as the jaguar (*Panthera onca*), puma (*Felis concolor*), ocelot (*Felis pardalis*) and red macaw (*Ara macao*). Laguna del Tigre, one of the protected areas, contains Central America's largest freshwater wetland.

Threats – Deforestation has been widespread due to the expansion of both crops and cattle; these are, in turn, linked to population growth, from both high in-migration and high fertility rates; illegal hunting and timber extraction; and some plantation agriculture (e.g., African palm plantations in the south).

Driving Forces

Push Factors – Migrants to the Peten come from various geographic locations within Guatemala and are subject to diverse push factors in their areas of origin. These factors include landlessness (highly skewed land distribution), poverty, lack of employment opportunities, population growth and environmental degradation. Political and social conflicts have also been important, notably the civil war and related social unrest and insecurity.

Pull Factors – The main attraction is the availability of land for agricultural colonization, raising crops and cattle. Additionally, the relative remoteness of the region provided refuge for those seeking to escape the civil unrest and violence in other parts of the country. Over time, the presence of relatives or friends already residing in the region facilitated settlement, as did the expansion of roads developed for timber and chicle extraction.

Interventions

Influencing Migration – A number of strategies have been proposed to reduce the motivations of people leaving their areas of origin in Guatemala, including land reform, family planning to reduce population growth, and improvements in health care facilities and other infrastructure to enhance the quality of life in areas of origin. Other proposed strategies involve job creation and technical assistance to improve agricultural incomes.

In late August 2005, ProPeten, an independent Guatemalan NGO, launched a radio soap opera portraying people's lives on the frontier and their struggles for land. The show is broadcast in the Q'eqchi' language in southern Peten, Belize and Izabal. Liza Grandia, emeritus board member of ProPeten, who helped develop this program, is working toward rebroadcasting the show in migrants' places of origin to raise awareness about the challenges of life on the frontier and the scarcity of land in the Peten (Grandia, pers. comm. 2005).

Reducing Impacts (in destination area) – Initial attempts to resettle people away from core areas in the mid-1990s were challenging and provided many opportunities for learning. Since then, institutional capacity has improved and program administration has been strengthened. The success of relocation programs hinges on the satisfaction of resettled families. If not satisfied, they will return. Margoluis (2004) has observed that migrants engaged in the process of determining whether or not to settle in a particular location most often look for an adequate source of water for agriculture, road access to a nearby community and good soil fertility. When relocating

people and attempting to create new communities, it has also been found that differences in social structures and power relationships within the community can lead to conflict. In addition, ethnicity has proven to be a critical factor (Margolius *et al.* 2002). As part of the resettlement process in the Peten, migrants are provided with access to long-term low-interest loans and technical assistance to help them adapt (Margoluis, pers. comm. 2004).

Land titling is a long-term process in Guatemala that can take as much as a decade to complete, causing confusion, anger and feelings of abandonment by the government. However, according to Margoluis (2004), those who receive land titles are more positive about the reserve than those who do not. The current approach is to resettle people onto lands purchased from private owners rather than on unclaimed national lands in order to increase the pace of the titling process.

In the communities of Laguna del Tigre and Sierra de Lacandón, agreements of permanence were provided to resettled families as a land security arrangement, rather than a land tenure title, which provides user rights. These agreements provide for a specific number of families per community but do not specify how the land is to be used. As part of the agreement, the signer must not allow more settlers to establish themselves in the area. This approach grew out of the early difficulties with resettlement and was created to encourage those who refused to move. Unfortunately, the agreements are difficult to enforce.

Improved communication is a necessary strategy for long-term implementation of conservation programs and for facilitating productive relations between conservation staff and local residents. According to Margoluis (2004), there is significant confusion in the Peten region about the existence of the national parks and the restrictions that apply. She found just 20 percent of the respondents to her survey were aware that their house and land were located inside a protected area. She also found that individuals with legal titles are more likely to understand and accept restrictions related to park lands.

Reproductive health and family planning have been proposed as long-term interventions. The innovative DHS program conducted in the region in 1999 has increased understanding of the links between migration and resource use and their relationship to conservation and maternal-child heath (Grandia *et al.* 2001). Technical support for agriculture has been found to improve the productivity of land and household incomes and may decrease the pressure to clear more land on farms. Creation of alternative employment opportunities may provide sources of income that take labor away from farm plots and lead to less deforestation. Finally, increasing the presence of park guards and guard posts and intensifying the monitoring of park borders are generally considered to be beneficial.

Contacts

Cheryl Margoluis (Yale University Phd.);

David Carr (University of California at Santa Barbara);

Liza Grandia (Emeritus Board Member of ProPeten and Postdoctoral Fellow, Yale University)

References

Carr, D. 2004. Ladino and Q'eqchi Maya land use and land clearing in the Sierra de Lacandon National Park, Peten, Guatemala. *Agriculture and Human Values* 21:171–179.

Grandia, L. 2005. Personal Communication. Postdoctoral fellow, Yale University. August 29.

Grandia, L. 2006. *Unsettling: Land Dispossession of the Q'eqchi' Maya in the Frontier Colonization Process to the Guatemalan and Belizean Lowlands.* Published Doctoral Dissertation. Department of Anthropology, University of California, Berkeley, CA.

Grandia, L., Schwartz, N., Corzo, A., Obando, O. & Ochoa, L.H. 2001. *Peten's Integrated Demographic and Health Survey 1999: Report on the Module on Migration and Resource Use and Their Relationship With Conservation and Maternal-Child Health in Guatemala's Northern Frontier.* Collaborative report. Instituto Nacional de Estadistica, Guatemala City, Guatemala; United States Agency for International Development, Guatemala City, Guatemala; MEASURE DHS+, Macro International Inc., Calverton, Maryland.

Margoluis, C. 2004. Personal Communication. Yale University Phd. April 13.

Margoluis, C. 2004. *Tragic Choices and Creative Compromises: Managing Protected Areas With Human Settlements.* Unpublished Doctoral Dissertation. Yale University, New Haven, CT.

Margoluis, C., Beavers J. & Paiz, M.C. 2002. Relocating people out of private reserves. *Conservation in Practice* 3(2):30-33.

PLANNING INTERVENTIONS AND SELECTED RESOURCES

A sound understanding of the situation is important before planning interventions. Ideally, a situation analysis should be undertaken, drawing on biodiversity and natural resource reviews, stakeholder analysis, analysis of threats and opportunities at different levels, and socio-economic surveys. If a demographic survey exists, it may be very useful. This basic information enables the construction of a conceptual model. Following on from the basic conceptual model in Figure 4, Section 5, we worked with WWF Madagascar staff to adapt their existing conceptual model of migration in the Spiny Forest to this format. It is shown in Figure 5.

Once the conceptual framework is completed, individual results chains can be developed to identify possible interventions and document the assumptions behind them. The discipline of producing detailed results chains often provides a better understanding of the linkages and assists in the selection of priority interventions. It also provides a basis for monitoring to test the effectiveness of interventions and the underlying assumptions. Three results chains for the Spiny Forest are shown as examples in Figures 6 through 8: two for interventions in the area of origin, and one for the area of destination. The first two should give results in the medium term (e.g., 3–10 years), the third one in the longer term (e.g., more than 20 years).

The next step is to decide which combination of the several possible results chains should be selected as interventions. Given the complexity of push and pull factors driving migration, a multisectoral and multilevel approach is often necessary to reduce the likelihood of migration, as well as its impacts. Partnerships may be very important to leverage results. It is beyond the scope of this publication to go into planning methodology in depth; further information can be found from various sources, including those listed below.

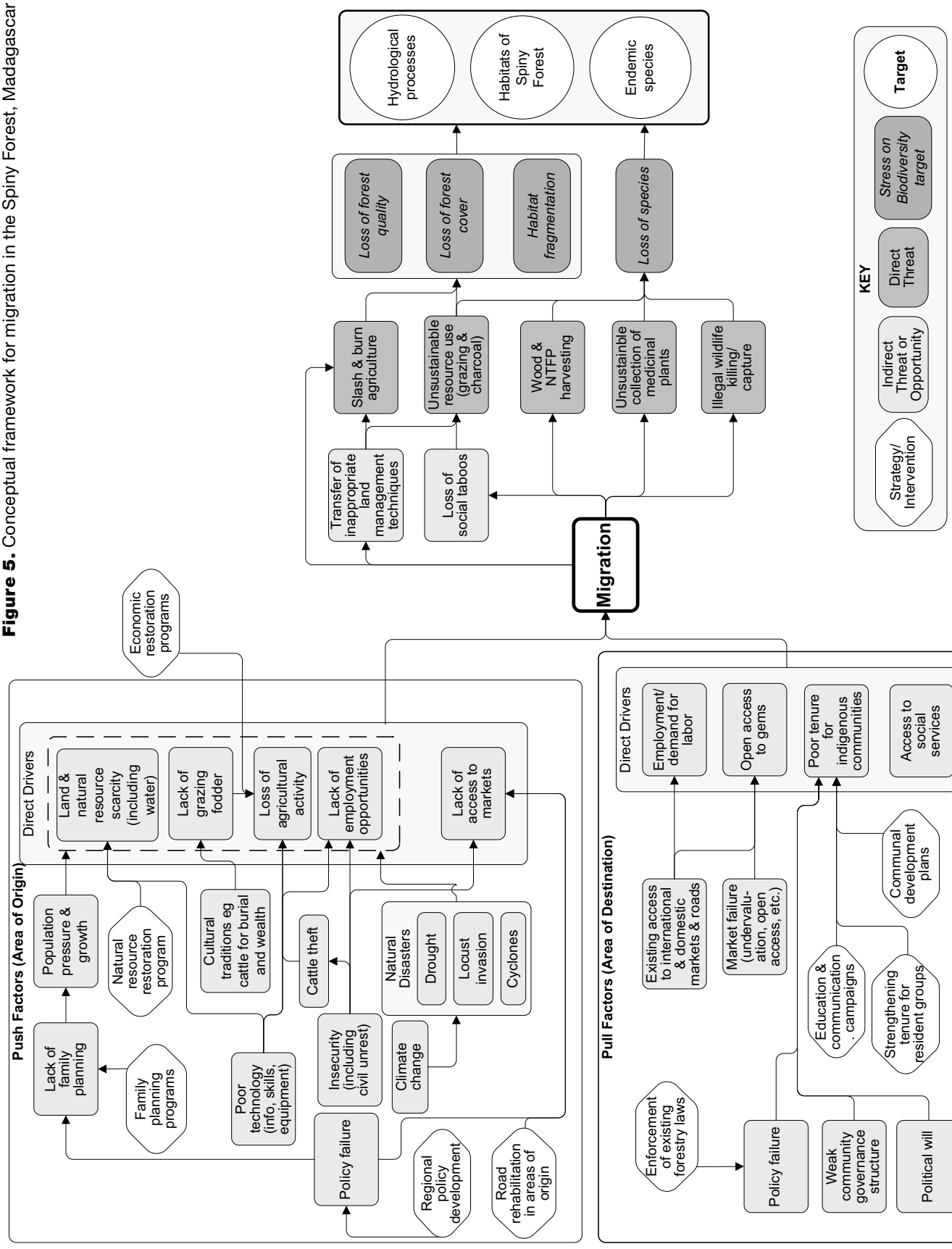


Figure 5. Conceptual framework for migration in the Spiny Forest, Madagascar

Figure 6. Results chain for road improvement in area of origin, Spiny Forest

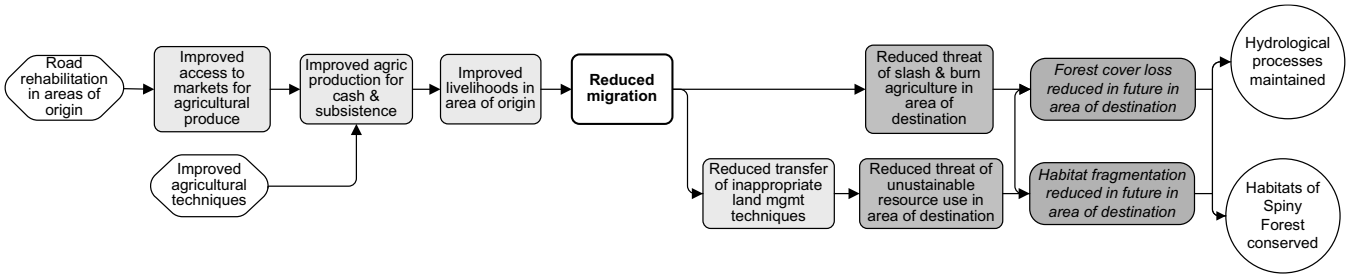


Figure 7. Results chain for strengthening forest tenure and control by resident groups in area of destination, Spiny Forest

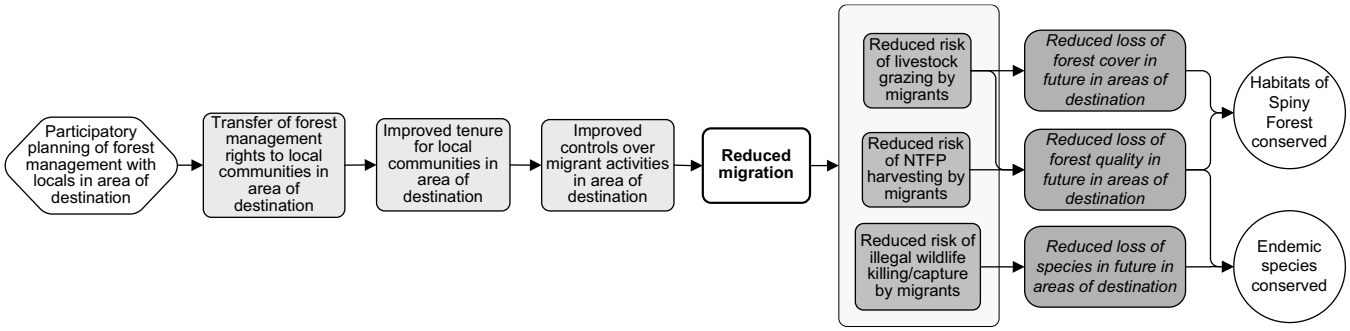
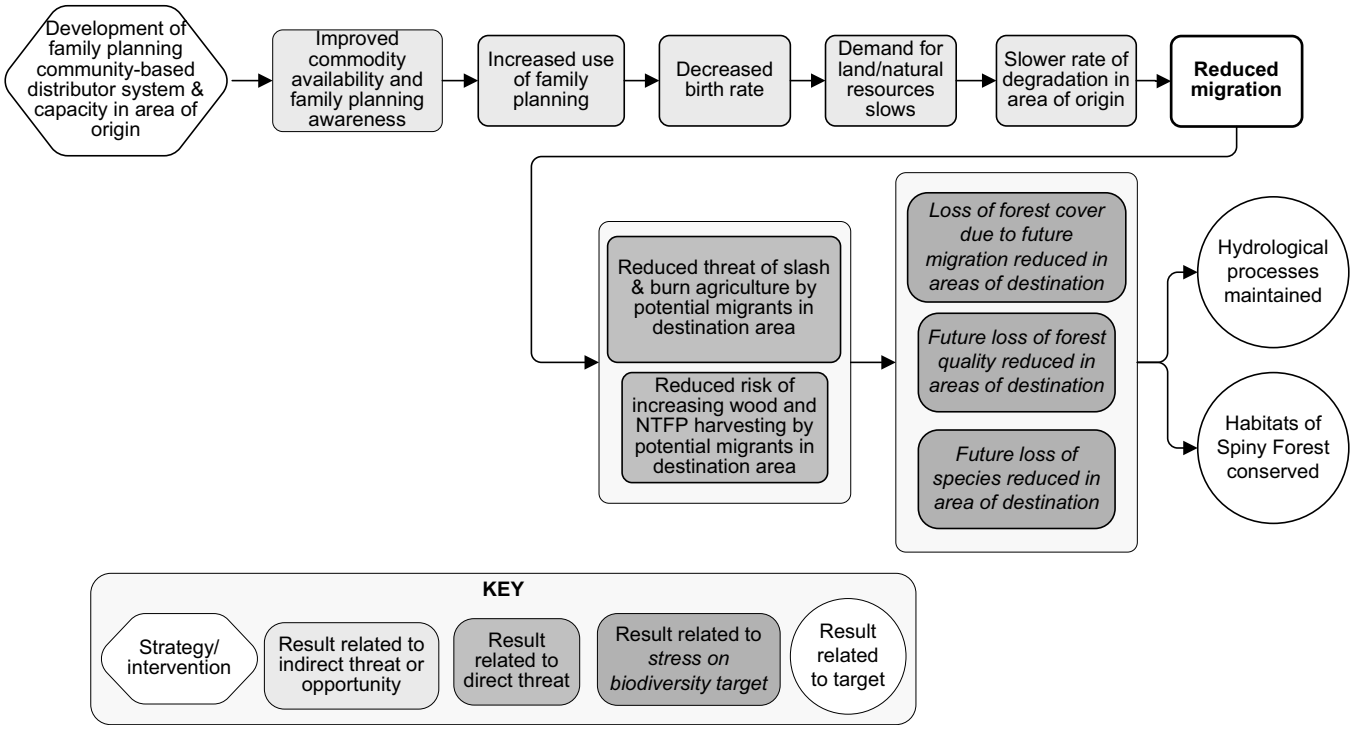


Figure 8. Results chain for provision of family planning services/reproductive health in area of origin, Spiny Forest



A.2.1 Resources to Help Plan Interventions

- WWF. 2006. WWF Standards of Conservation Project and Programme Management. Gland, Switzerland; Washington, DC; and Godalming, UK: WWF. Available: http://panda.org/about_wwf/how_we_work/conservation/programme_standards/index.cfm
- Biodiversity Support Program. 2001. Publications and tools from BSP. Available from WWF-US, 1250 24th Street, NW, Washington, DC 20037, USA. www.bsponline.org
- Community Conservation Coalition. 2003. *Putting Conservation in Context: Social Science Tools for Conservation Practitioners.* (CCC is a coalition of several international conservation, development, population and health organizations based in Washington, DC.) (Available in CD format at info@community-conservation.org.)
- Conservation Measures Partnership. Resources: http://fosonline.org/CMP.
- Margoluis, R.A. & Salafsky, N.N. 1998. *Measures of Success: Designing, Measuring and Monitoring Conservation and Development Projects.* Washington, DC: Island Press. (Spanish version available online at http://www.fosonline.org. December 22, 2006)
- Margoluis R.A. & Salafsky, N.N. 2001. *Is Our Project Succeeding? A Guide to Threat Reduction Assessment for Conservation.* Washington, DC: Biodiversity Support Program.
- Robinson, D.L. Undated. *Assessing Root Causes: A User's Guide.* Washington, DC: Macroeconomics for Sustainable Development Program Office, World Wildlife Fund.
- Wood, A., Stedman-Edwards, P. & Mang, J. 2000. *Root Causes of Biodiversity Loss.* Washington, DC: Earthscan Publications.

A.2.2 Resources to Help on Migration Technical Issues

- Barton, T., Borini-Feyerabend, G., de Sherbinin, A. & Warren, P. 1997. Basic methods and tools for PAR on population dynamics and the local environment. In *Our People, Our Resources: Supporting Local Communities in Participatory Action Research on Population Dynamics and the Local Environment.* pp. 217–233. Gland, Switzerland: World Conservation Union.
- Bruce, J. 1989. *Community Forestry Rapid Appraisal of Tree and Land Tenure: Community Forestry Note 5.* Rome, Italy: Food and Agriculture Organization of the United Nations.
- De Oliveira, N.B. 1999. *Community Participation in Developing and Applying Criteria and Indictors of Sustainable and Equitable Forest Management.* Bogor, Indonesia: Center for International Forestry Research (CIFOR).
- (CIFOR) Center for International Forestry Research. Local people, devolution and adaptive collaborative management programme tool box series. Online. Available: http://www.cifor.cigar.org/acm/pub/toolbox/html
- Jacobs, S. 1996. *Social Assessment and Participation: Methods and Tools.* Washington, DC: The World Bank.
- Shivakoti, G., Varughese, G., Ostrum, E., Shukla, A. & Thapa, G. (Eds.). 1997. *People and Participation in Sustainable Development: Understanding the Dynamics of Natural Resource Systems.* Bloomington, IN: Workshop in Political Theory and Policy Analysis.

A.2.3 Useful Web Sites

- http://www.bsponline.org
- http://www.fosonline.org
- http://www.indiana.edu/workshop/pubs.html
- http://www.iucn.org/themes/spg/Files/opor/opor.html
- http://www.iucn.org/themes/spg/Files/beyond_fences/beyond-fences.html
- http://www.populationenvironmentresearch.org/
- http://www.panda.org/mpo
- http://www.prb.org