INTRODUCTION

Section 1: Infrastructure Development and Ape Conservation

This, the third in the *State of the Apes* series, focuses on the impact of infrastructure—such as roads, railways and hydroelectric power plants—on ape conservation and welfare. While infrastructure for transport, energy and other purposes may be designed to improve peoples' lives, it often has negative consequences for local communities and biodiversity. The first two volumes of *State of the Apes* briefly considered the impact of infrastructure on apes and their habitat in relation to extractive industries and industrial agriculture; this volume explores that relationship more explicitly, featuring in-depth analysis of large-scale infrastructure projects.

The *State of the Apes* Series

Commissioned by the Arcus Foundation, the *State of the Apes* series strives to raise awareness of the impacts of human activities on all great ape and gibbon populations. Apes are vulnerable to a range of threats that are primarily driven by humans,

including hunting associated with the trade in wild meat, body parts and live animals; deforestation and degradation of habitat; and the transmission of disease. Interactions between humans and apes continue to increase as development and human population growth drive further incursions into spaces that are inhabited by apes. By using apes as an example, this publication series also aims to underscore the importance of wider species conservation.

State of the Apes covers all non-human ape species, namely bonobos, chimpanzees, gibbons, gorillas and orangutans, as well as their habitats. Ape ranges are found throughout the tropical belt of Africa and South and Southeast Asia. Robust statistics on the status and welfare of apes are derived from the Ape Populations, Environments and Surveys (A.P.E.S.) Portal (Max Planck Institute, n.d.-a). Abundance estimates of the different ape taxa are presented in the Abundance Annex, available on the *State of the Apes* website at www.stateoftheapes.com. The annex is updated with each new volume in the series, to allow for comparisons over time. Details on the socioecology and geographic range of each species are provided in the Apes Overview.

Each volume in the *State of the Apes* series is divided into two sections. Section 1 focuses on the thematic topic of interrogation, which in this case is infrastructure development (see Box I.1). The immediate objectives are to provide accurate information on the current situation, present various perspectives and, where applicable, highlight best practice. In the longer term, the key findings and messages are intended to stimulate debate, multi-stakeholder collaboration and changes to policies and practice that can facilitate the reconciliation of economic development and the conservation of biodiversity. Section 2 presents more general details on the status and welfare of apes, in their natural habitat and in captivity.

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Infrastructure Development and Ape Conservation

Both Africa and Asia are facing a number of development challenges, with expanding populations and increasing urbanization; rising demand for water, energy, food and other commodities on a local, regional and global scale; predicted hydrological variability due to climate change; and persistent poverty and inequality.

Dams appear to offer a tempting range of benefits to meet development needs—they can reduce floods, store water for irrigation, provide energy for burgeoning populations and contribute to regional integration. The social, environmental and economic costs and benefits of dams are not distributed evenly, however, and oftentimes they are not viable investments due to excessive cost and time overruns (International Rivers, n.d.-b). Large dams also affect the political, social and environmental landscape of a region.

Similarly, the development of road networks is promoted as contributing to economic and social development by providing

BOX I.1

Definition of Infrastructure

State of the Apes focuses on physical infrastructure and defines the term to refer to large, diverse structures that are built to enable the provision of services for households, industry and other entities (e.g., government buildings, state hospitals and schools) and that are closely aligned with economic development. For the purposes of this publication, *infrastructure* refers to fixed assets that can form part of a large network. The term encompasses bridges, geothermal power plants, hydropower dams, power lines and distribution networks, ports and industrial installations, such as mines and pipelines, railways, roads and tunnels.

access to markets and resources, without taking account of the environmental and social costs. At least 25 million kilometers of additional roads are anticipated worldwide by 2050—90% of them in developing nations, including many regions with exceptional biodiversity and vital ecosystem services (Global Road Map, n.d.). As much of the planned infrastructure is to be built in developing countries, ape habitat across the tropical belt of Africa and Asia will certainly be affected.

Before presenting chapter-by-chapter highlights of Section 1, this introduction explores the factors that influence the rate and extent of infrastructure development. Summaries of Chapters 7–8 appear in the introduction to Section 2 (see p. 198).

This volume describes various efforts to mitigate the effects of infrastructure, such as roads and hydropower, across specific sectors, including activism, planning, ecology, legislation and advocacy. To understand and be able to address the adverse impacts of infrastructure development, it is important to know where these investments are likely to occur and how rapidly they are developing. The following sections explore the role of incentives, capacity, institutions, corruption and finance in shaping infrastructure.

Incentives and Capacity

Most reports about infrastructure investment depend on government budgets, policy documents, official pronouncements and company press releases for specific figures. These sources have often proved unreliable, however, as many planned projects never materialize, while others have large cost overruns. Moreover, both proponents and critics of infrastructure investments can benefit from exaggerating the rate at which investors support development projects. In some cases, the rate actually exceeds expectations.

What makes potential investors *want* to invest and what makes them *able* to do so? To arrive at meaningful answers, it is helpful to split the determinants of infrastructure investment into two broad categories: incentives and capacity. Factors that increase incentives and capacity to invest while also reducing disincentives can be expected to accelerate investment—and vice versa.

Incentives can be economic, political or both. Economic motives include generating export revenues, opening land for agriculture, accessing raw materials and moving goods between locations. Common political rationales are establishing government presence, populating border regions, building geopolitical alliances and capturing votes. Key disincentives include high construction costs and political or local opposition. Even when elites want infrastructure, they will not get it unless they have the capacity to produce and maintain it. That requires political support, funds, technical and managerial capacity, and the ability to overcome regulatory and administrative hurdles. Generating new sources of tax revenue and implementing fiscal decentralization provide both incentives and capacity for infrastructure investment (Kis-Katos and Suharnoko Sjahrir, 2014).

Institutions, Instability and Corruption

Political instability, inadequate planning, limited administrative capacity, a lack of trained staff and bureaucratic delays typically reduce a government's ability to provide infrastructure, while also undermining private interest in partnerships (Berg *et al.*, 2012; Galinato and Galinato, 2013; Gillanders, 2013; Kikawasi, 2012; Percoco, 2014). These factors cause delays, disruptions and poor maintenance, impeding effective investment (see Case Study 5.3). While opportunities for bribes may motivate officials to promote

projects, corruption raises the costs and slows progress (Collier, Kirchberger and Soderbom, 2015).

In principle, strong judicial and regulatory systems, which ensure that projects meet environmental and social standards, can deter harmful infrastructure investments in forest regions. That has certainly happened on some occasions. On balance, however, instability, institutional limitations and corruption are probably greater constraints on infrastructure investments than well-functioning regulatory systems (Collier *et al.*, 2015; Galinato and Galinato, 2013).

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Political Support and Opposition

All the dominant economic paradigms see infrastructure investments as inherently positive. That applies as much to the more developmental state visions as to the more neoliberal, free-market views. This consensus gives these investments legitimacy and makes it easier to promote them. Nonetheless, in some regions, indigenous peoples and rural communities adamantly oppose such investments, particularly when they are linked to large-scale mining and energy projects or plantations. National and international environmental groups often support such opposition. Through demonstration, litigation, advocacy and other strategies, they have blocked or delayed many projects (see Case Study 6.2).

Changes in Investment Sources

Most funds for infrastructure come from the governments of developing countries, multilateral development banks (MDBs), bilateral aid agencies, emerging-market development banks and private companies. Each type of agency or lender has different goals, strengths and weaknesses and operates in distinct environments. For decades, national governments in developing countries usually had to secure some funding from MDBs and/or bilateral development agencies if they wished to undertake large infrastructure investment projects. Their weak tax base limited their ability to finance large projects on their own. Conversely, the MDBs were interested in making large loans and had few resource constraints.

After the World Bank and other MDBs adopted environmental and social safeguards in the 1980s, the environmental impacts of large infrastructure projects came under greater scrutiny. It became harder for national governments to borrow for projects that were likely to harm the environment (Currey, 2013). The MDBs were concerned about their reputation and pressure from non-governmental organizations (NGOs).

Over the last decade or so, however, various trends have made it easier for national governments to obtain funds for controversial projects. Emerging-market development banks—such as the Asian Infrastructure Investment Bank, Brazilian Development Bank, China Development Bank, Development Bank of Southern Africa and New Development Bank—have partially replaced the traditional MDBs. These new banks put a premium on geopolitical considerations, such as gaining political allies, securing access to markets and raw materials, and supporting national companies. They tend to be less concerned about environmental considerations and less susceptible to pressure from NGOs (Kahler *et al.*, 2016). There has also been an upswing in private funding, as market-friendly ideologies and low international interest rates have led governments to work with private banks and construction companies. Meanwhile, to remain competitive, some believe that the World Bank has weakened its own safeguard policies (see Box 1.4 and Box 5.1).

These evolving dynamics can greatly affect levels of investment, as can domestic instability. In Brazil, for example, corruption scandals and the national political and economic crisis recently forced the Brazilian Development Bank to curtail its activities beyond the country's borders (Molina *et al.*, 2015).

Chapter Highlights: Infrastructure Development and Ape Conservation

The first six chapters of this volume of *State of the Apes* interrogate the interface between ape conservation and large-scale infrastructure development. **Chapter 1** presents an overview of proposed infrastructure projects in the ape habitats of Asia and Africa. It explores the role of major economies such as China and multilateral financial institutions in the expansion of infrastructure in the tropical belt and considers the potential impacts of specific planned infrastructure projects. **Chapter 2** assesses the impacts of infrastructure development on apes and people, highlighting issues ranging from displacement and loss of ancestral land, and habitat destruction and forest degradation, to disruptions in access to food, clean water and shelter, to road kills, increased poaching and the introduction of disease. **Chapter 3** discusses the findings of a historical analysis of road construction in three ape sites and describes how these infrastructure projects have affected ape forest habitat over time. The chapter proposes approaches that can serve to minimize environmental damage, as well as tools that allow for effective forest monitoring. **Chapter 4** explores the robustness of one of the most commonly used conservation strategies—the establishment of protected areas—in the face of large-scale infrastructure development. Results suggest that as roads spread across sub-Saharan Africa, they will cut through one-third of all existing protected areas. The chapter encourages a more considered approach to land use and infrastructure planning, as well as the application of the "mitigation hierarchy" to reduce threats to critical habitats. **Chapter 5** presents three case studies on proposed road developments in the ape ranges of Cross River State, Nigeria; the Dawei region connecting Thailand and Myanmar; and the northern region of the Democratic Republic of Congo (DRC). In documenting the role of conservation organizations in these cases, the chapter identifies a variety of approaches and common challenges. **Chapter 6** considers the engagement of social and environmental actors in relation to energy development. It presents case studies involving dam construction projects in Cameroon and Sarawak, Malaysian Borneo, a geothermal project in Indonesia's Leuser ecosystem, as well as a planning approach developed by a conservation organization to mitigate the impacts of hydropower development.

Section 2 provides updates on *in situ* ape conservation in Africa and Asia (Chapter 7) and the welfare of apes in captivity (Chapter 8). The highlights for these two chapters are included in the Introduction to Section 2 (see p. 198).

> "Over the last decade or so, various trends have made it easier for national governments to obtain funds for controversial infrastructure projects through emerging-market development banks and private funding."

Chapter 1: Challenges and Opportunities in Sustainable Infrastructure Development

This chapter considers the current unprecedented rate of global infrastructure expansion and the factors that typically prevent resulting benefits from being distributed equitably. It explores the role of multilateral financial institutions and major economies, such as China, in backing proposed

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infrastructure projects in the ape range states of Africa and Asia. Specifically, it examines the extent to which ape habitat is likely to be degraded by "development corridors" such as the LAPSSET (Lamu Port, South Sudan, Ethiopia Transport) corridor, which is to slice through the Congo Basin; the Central African Iron Ore Corridor, which will cross the Republic of Congo, Cameroon and Gabon, comprising road, rail and hydropower components; and the Simandou iron ore project in southeastern Guinea. The chapter identifies promising alternatives to such destructive development projects, highlighting the advantages of "leapfrogging" traditional grid-based energy infrastructure in favor of decentralized renewables, as well as the benefits of carrying out strategic land use planning to protect ape habitat and biodiversity more broadly.

Chapter 2: Impacts of Infrastructure on Apes and People

This chapter assesses the environmental and social impacts of infrastructure development, highlighting issues ranging from displacement, loss of land and habitat, and forest degradation to disruptions in access to food, clean water and shelter. Among the most serious environmental impacts is the increased access that infrastructure-related roads and settlements provide to critical habitat. Such access tends to exacerbate illegal hunting, habitat loss and fragmentation, degradation of ecological integrity, the frequency of disease outbreaks, and wildlife mortality and injury rates. Projections show that, by 2030, fewer than 10% of ape ranges in Africa and only about 1% of those in Asia will remain untouched by infrastructure development and the associated habitat disturbance. If this trajectory is to be avoided, greater incorporation of species ecology into infrastructure planning is required. Significant knowledge gaps remain, however.

In assessing the social impacts of infrastructure development, the chapter considers road and rail projects in southern Cameroon, as well as the Chad–Cameroon pipeline. When undertaken in customary land, such infrastructure development can have a negative impact on the livelihoods, cultural practices and norms of indigenous peoples, who traditionally manage and utilize forest resources sustainably. Conservation efforts designed to mitigate and offset adverse effects of infrastructure development on biodiversity can also have negative impacts on indigenous peoples.

Chapter 3: Effects of Road Projects in Ape Landscapes

This chapter presents analysis of changes in forest cover around roads that were substantially upgraded between 2000 and 2014 in ape forest habitat in Northern Sumatra, Indonesia, and western Tanzania, as well as in Peru's tropical forest, which is home to primates but not apes. In these case studies, satellite imagery and associated spatial data analysis tools are used to reveal changes in canopy cover. The studies demonstrate that geospatial data can serve to inform road siting and the design of measures to minimize the impact of infrastructure on wildlife habitat.

The findings show that forested areas near roads are highly vulnerable to deforestation. In particular, roads facilitate the development of uncontrolled settlements, which tends to be accompanied by a rise in poaching and farming; they also enable illegal access to protected areas, such as the Leuser Ecosystem. The chapter argues that an integrated approach to infrastructure planning is required if critical habitats are

to be preserved. In instances where roads cannot be rerouted to avoid protected areas, such planning can ensure that road design incorporates measures to mitigate negative impacts on natural areas. The chapter illustrates the value of satellite imagery and platforms such as Global Forest Watch to both forest monitoring and sustainable road development.

Chapter 4: Apes, Protected Areas and Infrastructure in Africa

In Africa, many development corridors are being planned or are already under construction in areas of high environmental value, including critical ape habitat. This chapter shows that as road networks and related infrastructure spread across equatorial Africa, they are likely to cut through more than one-third of all existing protected areas in sub-Saharan Africa. Bwindi Impenetrable National Park, a stronghold of the mountain gorilla, is among the areas at risk. Across the continent, protected areas that are considered to be obstacles to large-scale infrastructure development are particularly vulnerable to reduction or degazzettement.

The chapter encourages a more considered approach to land use and infrastructure planning. It argues for an expanded application of the "mitigation hierarchy" to reduce threats to critical habitats while also calling for viable financial strategies to help developing nations meet pressing economic and food-production needs. The chapter presents the DRC's Virunga National Park as an example of a successful approach to balancing economic and environmental priorities; as part of its program of socio-economic development, the park provides energy and tourism revenue to local communities and businesses.

Chapter 5: Case Studies of Large-Scale Road Development

This chapter explores how advance planning that is evidence-based and inclusive can help to minimize the negative impacts of road development on biodiversity. To that end, it presents three case studies on proposed road development in ape ranges in Africa and Asia: the Cross River superhighway of Cross River State, Nigeria; the Dawei road between Thailand and Myanmar; and the Pro-Routes project in the DRC. By interrogating how conservation actors are engaging with different road projects that present major threats to great ape and gibbon habitat, the analysis reveals a range of approaches and common challenges.

The case studies demonstrate that sustainable infrastructure development requires the active participation of a range of stakeholders. Specifically, the chapter highlights the importance of advocacy by local and international conservation NGOs in Nigeria, civil society engagement with industry and government actors in Myanmar, and the inclusion of conservation actors early on in the planning and implementation of mitigation measures in the DRC. All case studies underscore the importance of integrating ecosystem and wildlife considerations in the planning and design of roads. Unless political actors and decision-makers prioritize environmental concerns, however, conservationists will remain reliant on standards and safeguards that may be weakly enforced or poorly applied, if at all.

Chapter 6: Case Studies of Renewable Energy Projects

Hydropower is by far the largest source of renewable energy, and projections suggest that its global capacity may double by 2040.

This expansion is likely to entail the construction of thousands of new large dams and tens of thousands of small dams. The plans are proceeding despite the availability of more sustainable, more cost-effective energy alternatives, and notwithstanding evidence that the oft-touted economic benefits of dams rarely materialize for the vulnerable sectors of society. The rapid growth of hydropower is certain to have substantial environmental and social ramifications, ranging from the disruption of hydrological connectivity and the destruction of upstream terrestrial habitats to the emission of high levels of greenhouse gases. The chapter indicates that hydropower development is likely to impact apes in Asia more significantly than in Africa, with gibbons identified as particularly vulnerable.

Two of the chapter's case studies explore the environmental and social impacts of dam development in ape ranges in Cameroon and in Sarawak, Malaysian Borneo. The first considers the challenges of implementing best practices designed to protect apes once a project shifts from the planning to the construction phase; the second explores how community activism and collaboration between communities and scientists can block the construction of destructive dams. Given that hydropower is not the only form of renewable energy associated with adverse impacts, the chapter also features a case study on the implications of a proposed geothermal plant in Sumatra's Leuser Ecosystem. The chapter also presents a system-scale hydropower planning and design framework—"Hydropower by Design"—which was developed to mitigate the impacts of hydropower development.

Conclusion

On a spectrum of government capacity to undertake infrastructure development, the conservation of ape habitat appears to be most likely at the opposite extremes. At one end of the spectrum, weak, unstable and corrupt governments are unable to fund, construct or maintain projects that would threaten forests, thus inadvertently preserving habitat. At the other end, in stable countries with transparent governments and effective regulatory systems, opposition forces and civil society can put a brake on harmful projects. The greatest risks to wildlife and their habitat lie between these extremes, in countries where institutions are weak, rulers and officials are corrupt, and conservation actors are silenced or treated with indifference.

Many ape range states sit in the middle of this spectrum. This volume of *State of the Apes* seeks to avert situations in which the natural world is particularly vulnerable to infrastructure development, by providing accurate information on the current situation, identifying challenges and possible solutions, and leveraging the iconic status of apes to contribute to the overall conservation of tropical forest ecosystems. It demonstrates the value of anticipating development, planning early, forming partnerships, establishing robust monitoring and relying on empirical evidence to reconcile conservation objectives with those of infrastructure development in the ape ranges of Africa and Asia—and in wildlife habitat elsewhere.

Acknowledgments

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Endnotes

1 Ford Foundation (www.fordfoundation.org)

2 Arcus Foundation (www.arcusfoundation.org)