

# State of the Apes

## Infrastructure Development and Ape Conservation

Infrastructure development in Africa and Asia is expanding at breakneck speed, largely in biodiversity-rich developing nations. The trend reflects governments' efforts to promote economic growth in response to increasing populations, rising consumption rates and persistent inequalities. Large-scale infrastructure development is regularly touted as a way to meet the growing demand for energy, transport and food—and as a key to poverty alleviation. In practice, however, road networks, hydropower dams and “development corridors” tend to have adverse effects on local populations, natural habitats and biodiversity. Such projects typically weaken the capacity of ecosystems to maintain ecological functions on which wildlife and human communities depend, particularly in the face of climate change.

This volume—*State of the Apes: Infrastructure Development and Ape Conservation*—presents original research and analysis, topical case studies and emerging tools and methods to inform debate, practice and policy with the aim of preventing and mitigating the harmful impacts of infrastructure projects on biodiversity. Using apes as a proxy for wildlife and ecosystems themselves, it identifies opportunities for reconciling economic and social development with environmental stewardship.

This title is available as an open access eBook via Cambridge Core and at [www.stateoftheapes.com](http://www.stateoftheapes.com).

# State of the Apes

## Series editors

Helga Rainer                      Arcus Foundation

Alison White

Annette Lanjouw                Arcus Foundation

The world's primates are among the most endangered of all tropical species. All great ape species – gorilla, chimpanzee, bonobo and orangutan – are classified as either Endangered or Critically Endangered. Furthermore, nearly all gibbon species are threatened with extinction. Whilst linkages between ape conservation and economic development, ethics and wider environmental processes have been acknowledged, more needs to be done to integrate biodiversity conservation within broader economic, social and environmental communities if those connections are to be fully realized and addressed.

Intended for a broad range of policymakers, industry experts and decision-makers, academics, researchers and NGOs, the *State of the Apes* series will look at the threats to these animals and their habitats within the broader context of economic and community development. Each publication presents a different theme, providing an overview of how these factors interrelate and affect the current and future status of apes, with robust statistics, welfare indicators, official and various other reports providing an objective and rigorous analysis of relevant issues.

## Other Titles in this Series

Arcus Foundation. 2015. *State of the Apes: Industrial Agriculture and Ape Conservation*. Cambridge: Cambridge University Press.

Arcus Foundation. 2014. *State of the Apes: Extractive Industries and Ape Conservation*. Cambridge: Cambridge University Press.

## Other Language Editions

### Bahasa Indonesia

Arcus Foundation. 2018. *Negara Kera: Pembangunan Infrastruktur dan Konservasi Kera*.

Arcus Foundation. 2015. *Negara Kera: Pertanian Industri dan Konservasi Kera*.

Arcus Foundation. 2014. *Negara Kera: Industri Ekstraktif dan Konservasi Kera*.

### French

Arcus Foundation. 2018. *La planète des grands singes: Le développement des infrastructures et la conservation des grands singes*.

Arcus Foundation. 2015. *La planète des grands singes: L'agriculture industrielle et la conservation des grands singes*.

Arcus Foundation. 2014. *La planète des grands singes: Les industries extractives et la conservation des grands singes*.

# State of the Apes

Infrastructure Development and  
Ape Conservation

CAMBRIDGE

arcus  
FOUNDATION

## CAMBRIDGE UNIVERSITY PRESS

University Printing House, Cambridge CB2 8BS,  
United Kingdom

Cambridge University Press is part of the University  
of Cambridge.

It furthers the University's mission by disseminating  
knowledge in the pursuit of education, learning and  
research at the highest international levels of excellence.

[www.cambridge.org](http://www.cambridge.org)

Information on this title:

[www.cambridge.org/9781107139688](http://www.cambridge.org/9781107139688)

DOI: 10.1017/9781108436427

© Cambridge University Press 2018

This work is in copyright. It is subject to statutory  
exceptions and to the provisions of relevant licens-  
ing agreements; with the exception of the Creative  
Commons version, the link for which is provided  
below, no reproduction of any part of this work may  
take place without the written permission of  
Cambridge University Press.

An online version of this work is published at <http://dx.doi.org/10.1017/9781108436427> under a Creative Commons Open Access license CC-BY-NC-ND 4.0 which permits re-use, distribution and reproduction in any medium for non-commercial purposes providing appropriate credit to the original work is given. You may not distribute derivative works without permission. To view a copy of this license, visit <https://creativecommons.org/licenses/by-nc-nd/4.0>.

All versions of this work may contain content repro-  
duced under license from third parties. Permission to  
reproduce this third-party content must be obtained  
from these third-parties directly. When citing this  
work, please include a reference to the DOI 10.1017/  
9781108436427.

First published 2018

Printed in the United Kingdom by Clays, St Ives plc,  
Elcograf S.p.A.

*A catalogue record for this publication is available from  
the British Library*

ISBN 978-1-108-42321-2 Hardback

ISBN 978-1-108-43641-0 Paperback

Cambridge University Press has no responsibility for  
the persistence or accuracy of URLs for external or  
third-party internet websites referred to in this publica-  
tion, and does not guarantee that any content on such  
websites is, or will remain, accurate or appropriate.

## Credits

### Editors

Helga Rainer, Alison White and  
Annette Lanjouw

### Production Coordinator

Alison White

### Editorial Consultant and Copy-editor

Tania Inowlocki

### Designer

Rick Jones, StudioExile

### Cartographer

Jillian Luff, MAP*grafix*

### Fact-checker

Rebecca Hibbin

### Proofreader

Sarah Binns

### Referencing

Eva Fairnell

### Indexer

Caroline Jones, Osprey Indexing

### Cover photographs:

Background: © Jabruson

Bonobo: © Takeshi Furuichi

Gibbon: © IPPL

Gorilla: © Annette Lanjouw

Orangutan: © Jurek Wajdowicz, EWS

Chimpanzee: © Nilanjan Bhattacharya/  
Dreamstime.com

## Foreword

Our world is on the verge of unprecedented economic and environmental change. While access to technology and opportunity are dramatically improving many parts of the planet, we also see climate change and widening inequality putting that progress in jeopardy. Even though new infrastructure investments—in roads, dams, pipelines and railways—promise economic prosperity for poorer countries, the risks such projects pose threaten to outweigh the benefits.

Look no further than what is happening to the world's population of apes across Africa and southeast Asia. The fragmentation and exploitation of tropical forests is a direct threat to apes—compromising their habitat, making food scarce, and bringing dangers like poaching and disease. As a result, their numbers are decreasing everywhere. Today, many ape species are on the precipice of extinction.

As this latest volume of *State of the Apes* argues, our well-being is inextricably linked to the well-being of our environment—and the well-being of all species that call our planet home.

That is in part because this same forest destruction is equally devastating to forest-dependent *people*. Industrial-scale infrastructure development has a significant, detrimental impact on local communities that have a long-term relationship with the forest. These rural and indigenous communities frequently don't see the economic benefits brought by new roads and power plants; instead they see their land taken away, without any just compensation or respect for their voices or rights.

Moreover, these developments have even wider ramifications for our environment. When we eliminate forests and fail to lift up the communities that protect them, we

dramatically increase the amount of CO<sub>2</sub> in our atmosphere. When we abuse our lands, we severely weaken our position in the fight against climate change.

In other words, when apes are displaced—when their forests are degraded and their lives are devalued—humans are too. When we ignore the larger consequences of these massive infrastructure projects, especially in the name of inequitable and unjust gain, the whole world suffers.

Our planet and our communities are in urgent need of a more sustainable, equitable kind of economic development—one that empowers everyone, while protecting the planet's life and resources.

At the Ford Foundation, we understand that all these issues are deeply intertwined, and to address them comprehensively, the solutions must be similarly interconnected. The question is: how do we strike a balance that enables development while also allowing apes and other species, local communities, the environment and the economy to thrive?

This book is aimed at helping us answer that difficult question. Through reasoned, peer-reviewed science and practical examples, *State of the Apes* shows that though there may always be trade-offs, smart policy comes from considering what will create long-term benefits for all. It offers real solutions for how we plan, organize and educate to produce socially inclusive and green infrastructure. And it reminds us that both long-term environmental sustainability and long-term economic progress are the result of *equitable* and just solutions—not unsustainable or corrupt investments.

Most importantly, this volume demonstrates how equitable development is not only a possibility, but a necessity.

We know we can't stop the world from developing, but we can make sure inevitable and necessary developments in infrastructure also contribute to the larger march of progress for all people, and protect the

environment. It's up to all of us to ensure that these projects are executed thoughtfully, responsibly and sustainably—that they are not destructive, but truly constructive.

At this critical moment—when governments, businesses and civil society organizations across the world are coming up against the dual threats of climate change and economic inequality—it has never been more essential that we keep our shared future in mind.

The *State of the Apes* series makes clear that charting a path forward is not about the state, or fate, of any one species, but about the fair and sustainable solutions that our world so desperately needs.

A handwritten signature in black ink, appearing to read "Darren Walker". The signature is stylized and fluid, with a large initial "D" and "W".

**Darren Walker**  
President  
Ford Foundation

# Contents

<b>The Arcus Foundation</b> .....	<b>ix</b>
<b>Notes to Readers</b> .....	<b>ix</b>
<b>Acknowledgments</b> .....	<b>x</b>
<b>Apes Overview</b> .....	<b>xii</b>

## Section 1

### Infrastructure Development and Ape Conservation

<b>Introduction</b> .....	<b>1</b>
<b>1. Towards More Sustainable Infrastructure: Challenges and Opportunities in Ape Range States of Africa and Asia</b> .....	<b>11</b>
Introduction	11
Infrastructure: A Game Changer	13
Drivers of Infrastructure Expansion	18
Emerging Threats to Ape Habitats	22
Social and Political Concerns	27
A Dire Need for Better Infrastructure Planning	28
Priorities for Change	31
<b>2. Impacts of Infrastructure on Apes, Indigenous Peoples and Other Local Communities</b> .....	<b>41</b>
Introduction	41
Ecological Impacts of Infrastructure on Apes	43
Steps Forward	54
Social Impacts of Infrastructure	60
Overall Conclusion	78
<b>3. Deforestation Along Roads: Monitoring Threats to Ape Habitat</b> .....	<b>81</b>
Introduction	81
Proposed New Approaches to Road Monitoring	83
Case Study Approach	86
Recommendations for Road Infrastructure in Ape Habitat	86
The Potential of Remote Sensing Tools to Detect and Monitor Changes in Ape Habitat	104
<b>4. Apes, Protected Areas and Infrastructure in Africa</b> .....	<b>107</b>
Introduction	107
African Ape Ranges and Protected Areas	109
Threats to Protected Areas from Infrastructure	111
Protected Area Downgrading, Downsizing and Degazettement (PADDD) in Africa	116
The Mitigation Hierarchy: Reconciling Infrastructure and Ape Conservation	119
Future Threats and Prospects	128

<b>5. Roads, Apes and Biodiversity Conservation: Case Studies from the Democratic Republic of Congo, Myanmar and Nigeria</b> .....	<b>137</b>
Introduction	137
Overall Conclusion	164
<b>6. Renewable Energy and the Conservation of Apes and Ape Habitat</b> .....	<b>167</b>
Introduction	167
Global Hydropower: Drivers and Trends	171
Impacts of Hydropower	172
Hydropower and Apes	174
Conclusion	195
<b>Section 2</b>	
<b>The Status and Welfare of Great Apes and Gibbons</b>	
<b>Introduction</b> .....	<b>198</b>
<b>7. Mapping Change in Ape Habitats: Forest Status, Loss, Protection and Future Risk</b> .....	<b>201</b>
Introduction	201
A Summary of the State of the Apes through the Lenses of Forest Cover and Protection, 2000–14	207
Forest Dynamics and Loss from 2000 to 2014	207
Annual Forest Loss Trends in Ape Habitat	216
Regular Monitoring of Forest Change	220
Conclusion	222
<b>8. The Status of Captive Apes</b> .....	<b>225</b>
Introduction	225
I. Beyond Capacity: Sanctuaries and the Status of Captive Apes in Shrinking Natural Habitats	227
Conclusion	254
II. The Status of Captive Apes: A Statistical Update	255
Conclusion	262
<b>Annexes</b> .....	<b>264</b>
<b>Acronyms and Abbreviations</b> .....	<b>279</b>
<b>Glossary</b> .....	<b>282</b>
<b>References</b> .....	<b>291</b>
<b>Index</b> .....	<b>344</b>



## The Arcus Foundation

The Arcus Foundation is a private grant-making foundation that advances social justice and conservation goals. The Foundation works globally and has offices in New York City, USA and Cambridge, UK. For more information visit:

- [arcusfoundation.org](http://arcusfoundation.org).
- Or connect with Arcus at:
- [twitter.com/ArcusGreatApes](https://twitter.com/ArcusGreatApes); and
- [facebook.com/ArcusGreatApes](https://facebook.com/ArcusGreatApes).

### Great Apes Program

The long-term survival of humans and the great apes is dependent on how we respect and care for other animals and our shared natural resources. The Arcus Foundation seeks to increase respect for and recognition of the rights and value of the great apes and gibbons, and to strengthen protection from threats to their habitats. The Arcus Great Apes Program supports conservation and policy advocacy efforts that promote the survival of great apes and gibbons in the wild and in sanctuaries that offer high-quality care, safety and freedom from invasive research and exploitation.

### Contact details

#### **New York office:**

44 West 28th Street, 17th Floor  
 New York, New York 10001, United States  
 +1 212 488 3000 / phone  
 +1 212 488 3010 / fax

#### **Cambridge office (Great Apes program):**

CB1 Business Centre  
 Leda House, 20 Station Road  
 Cambridge CB1 2JD, United Kingdom  
 +44 (0)1223 653040 / phone  
 +44.1223.451100 / fax

## Notes to Readers

### Acronyms and abbreviations

A list of acronyms and abbreviations can be found at the back of the book, starting on p. 279.

### Annexes

All annexes can be found at the back of the book, starting on p. 264, except for the Abundance Annex, which is available from the *State of the Apes* website:

- [www.stateoftheapes.com](http://www.stateoftheapes.com).

### Glossary

There is a glossary of scientific terms and keywords at the back of the book, starting on p. 282.

### Chapter cross-referencing

Chapter cross-references appear throughout the book, either as direct references in the body text or in brackets.

### Ape Range Maps

The ape range maps throughout this edition show the extent of occurrence (EOO) of each species. An EOO includes all known populations of a species contained within the shortest possible continuous imaginary boundary. It is important to note that some areas within these boundaries are unsuitable and unoccupied.

The Arcus Foundation commissioned the ape distribution maps in the Apes Overview, Figures AO1 and AO2, to provide the most accurate and up-to-date illustration of range data. These maps were created by the Max Planck Institute for Evolutionary Anthropology, who manage the A.P.E.S. portal and database. This volume also features maps created by contributors who used ape range data from other sources. As a consequence, the maps may not all align exactly.

## Photographs

We aim to include photographs that are relevant to each theme and illustrate the content of each chapter. If you have photographs that you are willing to share with the Arcus Foundation, for use in this series, or for multiple purposes, please contact the Production Coordinator ([awhite@arcusfoundation.org](mailto:awhite@arcusfoundation.org)) or the Cambridge office.

## Acknowledgments

The aim of the *State of the Apes* series is to facilitate critical engagement on conservation, industry and government practice and to expand support for great apes and gibbons. We are grateful to everyone who played a part, including meeting participants, our authors, contributors and reviewers, and those involved in the production of the book.

The support of Jon Stryker and the Arcus Foundation Board of Directors is essential to the production of this publication. We thank them for their ongoing support.

A key element outside of the thematic content is the overview of the status of apes, both in their natural habitats and in captivity. We extend our thanks to the captive-ape organizations that provided detailed information and to all the great ape and gibbon scientists who contribute their valuable data to build the A.P.E.S. database. Such collaborative efforts are key to effective and efficient conservation action.

Authors, contributors, reviewers and those who provided essential data and support are acknowledged at the end of each chapter. We could not have produced this book without them, and we thank them for their enduring patience and participation, in sickness and in health. Many of the photographs included were generously shared by their creators, who are credited alongside each one. Respect and thanks to those who read and reviewed the whole publication—no small task: Mihai Coroi, Cindy Rizzo and Tommaso Savini.

Particular thanks go to the following individuals, organizations and agencies: Marc Ancrenaz, Iain Bray, Stanley Brunn, Genevieve Campbell, the Center for International Forestry Research (CIFOR), Susan Cheyne, Bruce Davidson, Eric Dinerstein,

the Ford Foundation, Forest Peoples Programme (FPP), Getty Images, Hao Chunxu, Matthew Hatchwell, Randy Hayes, Tatyana Humle, Jack Hurd, the Jane Goodall Institute (JGI), Lin Ji, Anup Joshi, Justin Kenrick, Josh Klemm, Bill Laurance, Cath Lawson, Liz Macfie, the Max Planck Institute for Evolutionary Anthropology, Linda May, Adriana Gonçalves Moreira, Mott MacDonald, Steve Peedell, Adam Phillipson, Refuge for Wildlife, RESOLVE, Martha Robbins, Ian Singleton, Tenekwetche Sop, Gideon Suharyanto, the Sumatran Orangutan Conservation Programme (SOCP), Bob Tansey, The Biodiversity Consultancy (TBC), The Nature Conservancy (TNC), Anne Trainor, University of Minnesota, Steve Volkers, Darren Walker, Wildlife Conservation Society (WCS), Laura Wilkinson, Jake Willis and the World Wide Fund for Nature (WWF).

Our thanks also to Katrina Halliday and the team at Cambridge University Press for their support and commitment to this series.

We are committed to ensuring that these books are available to as many stakeholders as possible, not least by providing them in English, French and Bahasa Indonesia. Our thanks go to our cartographer, copy editor, graphic designers, indexer, proofreaders, reference editor and translators: Sarah Binns, Eva Fairnell, Tania Inowlocki, Caroline Jones, Rick Jones, Hyacinthe Kemp, Jillian Luff, Anton Nurcahyo, Islaminur Pempasa, H el ene Piantone, Erica Taube, Beth Varley and Rumanti Wasturini. All language editions are provided on the *State of the Apes* website, and our thanks go to the Arcus Communications team for managing this site, especially Stephanie Myers, Sebastian Naidoo and Bryan Simmons.

Many others contributed in a number of ways that cannot be attributed to specific content, by providing introductions,

anonymous comments or strategic advice, and by helping with essential administrative tasks. Marie Stevenson deserves particular thanks for her logistical support. We also thank everyone who provided much-appreciated moral support.

**Helga Rainer, Alison White  
and Annette Lanjouw**  
Editors