Photo: There has been a continent-wide decline in suitable environmental conditions within the geographic range of African apes. © Takeshi Furuichi, Wamba Committee for Bonobo Research

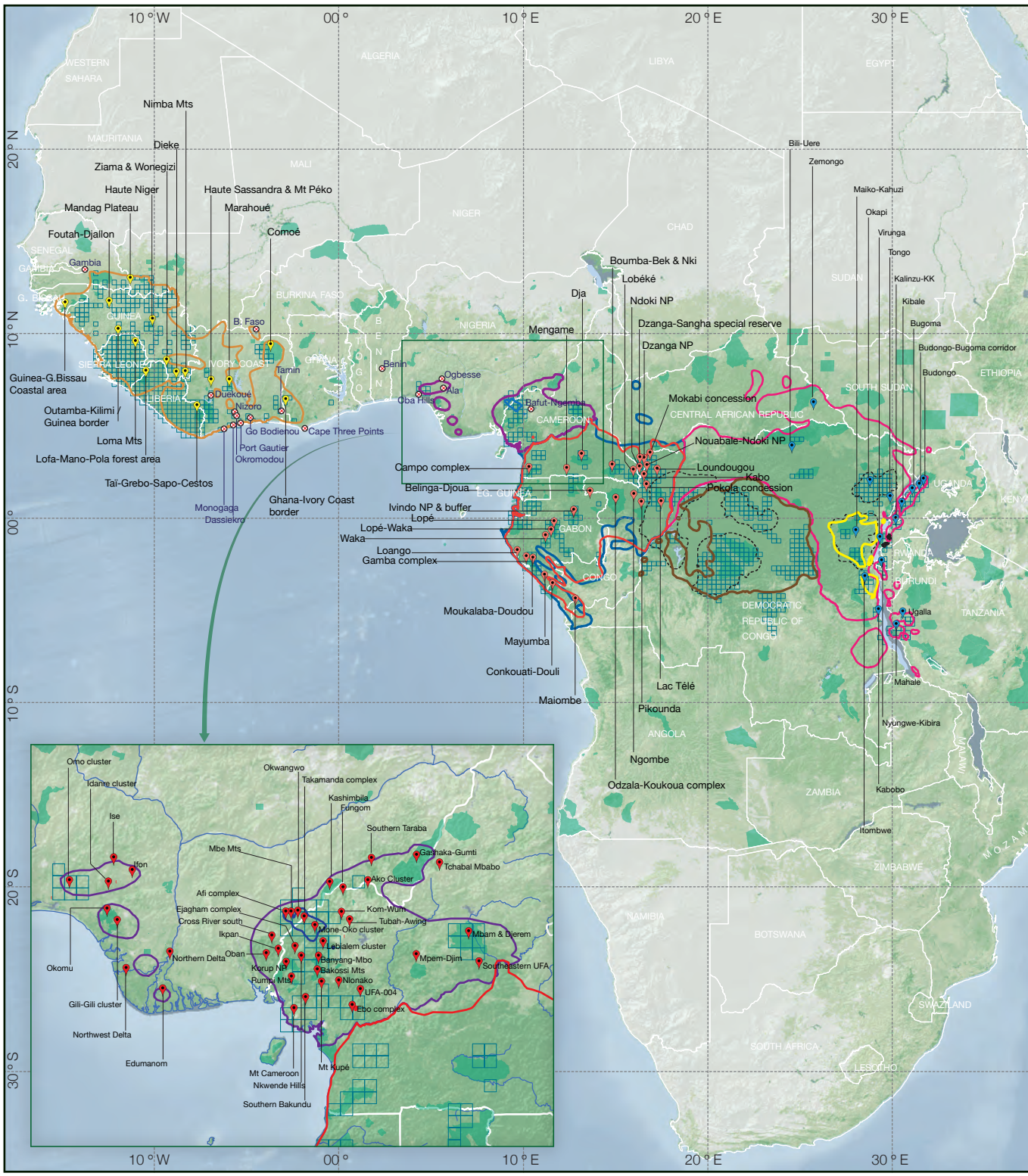
CHAPTER 9

The status of apes across Africa and Asia

Introduction

This chapter provides information on the conservation and welfare of great apes and gibbons. It focuses on the distribution and environmental conditions in which apes live in both Africa and Asia. The information presented is drawn from various sources, especially from the A.P.E.S. Portal (http://apesportal.eva.mpg.de), and can be used by decision-makers and stakeholders to contribute to the development of informed policies and effective planning. Although reference is made to particular great ape and gibbon taxa in some parts of the report, discussions are tailored to address issues about apes in general (not necessarily species specific). Because data quality and availability are not uniform across all ape taxa, regions, or

FIGURE 9.1 Ape distribution in Africa

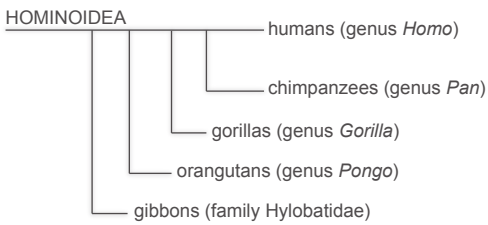


LEGEND

- Apes locally extinct
- Central chimpanzee priority sites
- Nigeria–Cameroon chimpanzee priority sites
- Western chimpanzee priority sites
- Eastern chimpanzee conservation units
- Bonobo conservation landscapes
- A.P.E.S. Database survey data coverage
- Protected areas (IUCN categories I-IV)

APE RANGE DISTRIBUTION

- Eastern Chimpanzee (*Pan troglodytes schweinfurthii*)
- Grauer's gorilla (*Gorilla beringei graueri*)
- Bonobo (*Pan paniscus*)
- Western lowland gorilla (*Gorilla gorilla gorilla*)
- Central chimpanzee (*Pan troglodytes troglodytes*)
- Nigeria–Cameroon chimpanzee (*Pan troglodytes ellioti*)
- Mountain gorilla (*Gorilla beringei beringei*)
- Western chimpanzee (*Pan troglodytes verus*)
- Cross River gorilla (*Gorilla gorilla diehli*)



SPECIES INFORMATION

CENTRAL CHIMPANZEE
Pan troglodytes troglodytes
Population in the wild: c. 70 000 - 117 000
Current range size: 811 425 km²
IUCN Redlist Classification: EN
Range size distribution
Angola: 0.79% range
Cameroon: 23.22% range
Central African Rep.: 4.87%
Congo: 32.72% range
Equatorial Guinea: 3.43% range
Gabon: 33.20% range
DR Congo: Present

WESTERN CHIMPANZEE
Pan troglodytes verus
Population in the wild: c. 23 080
Current range size: 771 975 km²
IUCN Redlist Classification: EN
Range size distribution
Burkina Faso: 0.42% range
Sierra Leone: 10.04% range
Senegal: 3.17% range
Mali: 2.97% range
Liberia: 11.64% range
G. Bissau: 1.88% range
Ghana: 2.55% range
Guinea: 33.77% range
Ivory Coast: 33.60% range
Population estimate source: Kormos et al., 2012.

WESTERN LOWLAND GORILLA
Gorilla gorilla gorilla
Population in the wild: c. 150 000
Current range size: 791 425 km²
IUCN Redlist Classification: CR
Range size distribution
Angola: 0.58% range
Central African Rep.: 2.64% range
Eq. Guinea: 3.54% range
Gabon: 36.66% range
Cameroon: 23.34% range
Rep. of Congo: 33.23% range

MOUNTAIN GORILLA
Gorilla beringei beringei
Population in the wild: c. 880
Current range size: 785 km²
IUCN Redlist Classification: CR
Range size distribution
Uganda: 47.07% range
Rwanda: 20.76% range
DR Congo: 32.23% range
Population estimate source: Gray et al., 2013.

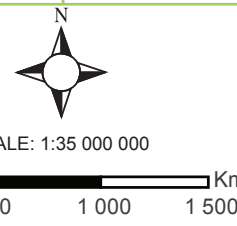
NIGERIA–CAMEROON CHIMPANZEE
Pan troglodytes ellioti
Population in the wild: c. 3 500 - 9 000
Current range size: 193 475 km²
IUCN Redlist Classification: EN
Range size distribution
Cameroon: 72.55% range
Nigeria: 27.45% range
Population estimate source: Morgan et al., 2011

EASTERN CHIMPANZEE
Pan troglodytes schweinfurthii
Population in the wild: c. 200 000 - 250 000
Current range size: 1105 675 km²
IUCN Redlist Classification: EN
Range size distribution
DR Congo: 82.49% range
Burundi: 0.65% range
Central African Rep.: 9.38% range
Rwanda: 0.20% range
South Sudan: 3.58% range
Tanzania: 1.71% range
Uganda: 1.97% range
Population estimate source: Plumptre et al., 2010.

BONOBO
Pan paniscus
Population in the wild: c. 15 000 - 20 000*
Current range size: 47 925 km²
IUCN Redlist Classification: EN
Range size distribution
DR Congo: 100% range
**Bonobo population is MINIMUM Estimate*
Population estimate source: IUCN and ICCN, 2012.

CROSS RIVER GORILLA
Gorilla gorilla diehli
Population in the wild: c. 200 - 300
Current range size: 12 000 km²
IUCN Redlist Classification: CR
Range size distribution
Cameroon: 66.08% range
Nigeria: 33.92% range
Population estimate source: Oates et al., 2007.

GRAUER'S GORILLA
Gorilla beringei graueri
Population in the wild: c. 2 000 - 10 000
Current range size: 75 225 km²
IUCN Redlist Classification: EN
Range size distribution
DR Congo: 100% range
Population estimate source: Maldonado et al., 2012



There is active, ongoing data collection to gather details about population numbers for apes in various locations across their entire range. Updated information will be made available on the A.P.E.S. Portal. Visit this portal at http://apesportal.eva.mpg.de for regular updates.

FIGURE 9.2 Ape distribution in Asia

LEGEND

- Priority ape conservation sites
- Bornean orangutan subspecies boundaries
- A.P.E.S. Database survey data coverage
- Protected areas (IUCN categories I-IV)

APE RANGE DISTRIBUTION

GIBBONS

- *Hoolock hoolock*
- *Hoolock leuconedys*
- *Hylobates abbotti*
- *Hylobates agilis*
- *Hylobates albibarbis*
- *Hylobates funerus*
- *Hylobates klossii*
- *Hylobates lar*
- *Hylobates moloch*
- *Hylobates muelleri*
- *Hylobates pileatus*
- *Nomascus annamensis*
- *Nomascus concolor*
- *Nomascus gabriellae*
- *Nomascus hainanus*
- *Nomascus leucogenys*
- *Nomascus nasutus*
- *Nomascus siki*
- *Symphalangus syndactylus*

ORANGUTANS

- *Pongo abelii*
- *Pongo pygmaeus*

SCALE: 1:35 000 000

SPECIES INFORMATION

SUMATRAN ORANGUTAN
Pongo abelii
Population in the wild: c. 6 660
Current range size: 8 641 km²
IUCN Redlist Classification: CR
Range size distribution
Indonesia (Sumatra)

SIAMANG
Symphalangus syndactylus
IUCN Redlist Classification: EN
Range countries
Thailand, Malaysia, and Indonesia

WHITE-HANDED GIBBON
Hylobates lar
IUCN Redlist Classification: EN
Range countries
Indonesia, Lao PDR, Malaysia, Myanmar, China, and Thailand

JAVAN GIBBON
Hylobates moloch
IUCN Redlist Classification: EN
Range countries
Indonesia

BORNEAN WHITE-BEARDED GIBBON
Hylobates albibarbis
IUCN Redlist Classification: EN
Range countries
Indonesia (Borneo)

AGILE GIBBON
Hylobates agilis
IUCN Redlist Classification: EN
Range countries
Indonesia, Malaysia, and Thailand

MÜLLER'S GIBBON / BORNEAN GRAY GIBBON
Hylobates muelleri
IUCN Redlist Classification: EN
Range countries
Indonesia, and Malaysia

ABBOTT'S / WEST BORNEAN GRAY GIBBON
Hylobates abbotti
IUCN Redlist Classification: EN
Range countries
Brunei Darussalam, Indonesia, and Malaysia

PILEATED GIBBON
Hylobates pileatus
IUCN Redlist Classification: EN
Range countries
Cambodia, Lao PDR, and Thailand

KLOSS' GIBBON
Hylobates klossii
IUCN Redlist Classification: EN
Range countries
Indonesia

EASTERN BORNEAN GRAY GIBBON
Hylobates funerus
IUCN Redlist Classification: EN
Range countries
Malaysia, and Indonesia

BORNEAN ORANGUTAN
Pongo pygmaeus
Population in the wild: c. 54 000
Current range size: 155 106 km²
IUCN Redlist Classification: EN
Range size distribution
Indonesia (Borneo)

WESTERN HOOLOCK GIBBON
Hoolock hoolock
IUCN Redlist Classification: EN
Range countries
Bangladesh, India, and Myanmar

EASTERN HOOLOCK GIBBON
Hoolock leuconedys
IUCN Redlist Classification: VU
Range countries
China, India, and Myanmar

NORTHERN YELLOW-CHEEKED GIBBON
Nomascus annamensis
IUCN Redlist Classification: Not assessed
Range countries
Cambodia, Lao PDR, and Viet Nam

WESTERN BLACK-CRESTED GIBBON
Nomascus concolor
IUCN Redlist Classification: CR
Range countries
China Lao PDR, and Viet Nam

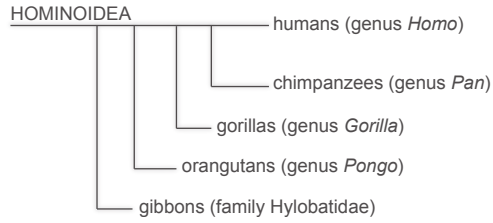
EASTERN BLACK-CRESTED / CAO VIT GIBBON
Nomascus nasutus
IUCN Redlist Classification: CR
Range countries
China, and Viet Nam

SOUTHERN YELLOW-CHEEKED GIBBON
Nomascus gabriellae
IUCN Redlist Classification: EN
Range countries
Cambodia, and Viet Nam

HAINAN GIBBON
Nomascus hainanus
IUCN Redlist Classification: CR
Range countries
China

NORTHERN WHITE-CHEEKED GIBBON
Nomascus leucogenys
IUCN Redlist Classification: CR
Range countries
Lao PDR, China, and Viet Nam

SOUTHERN WHITE-CHEEKED GIBBON
Nomascus siki
IUCN Redlist Classification: EN
Range countries
Lao PDR, and Viet Nam



There is active, ongoing data collection to gather details about population numbers for apes in various locations across their entire range. Updated information will be made available on the A.P.E.S. Portal. Visit this portal at http://apesportal.eva.mpg.de for regular updates.

even countries, we refer to specific cases for which data are available and reliable. The current chapter has not yet been expanded to fully include the gibbons and, as such, data mining for this family is still limited; however, additional data collection will occur in between this and the subsequent edition of *State of the Apes* to ensure that gibbons are well represented in future.

The body of the report is organized into four parts (plus an online-only section):

- **Spatial distribution**. This section comprises two maps showing ape distribution and other relevant baseline information about the different subspecies.
- **Suitable environmental conditions for African apes**. In this section, statistics on modeled Suitable Environmental Conditions (SEC) for great apes in Africa are presented, first at the species level and then at the country level. These statistics were computed from models calibrated using ape survey data drawn from the A.P.E.S. Portal, covering eight of the nine African ape taxa (mountain gorillas not included).
- **Apes in human-dominated landscapes**. This section addresses and attempts to simplify the complexity of the interaction of factors that affect ape population abundance and survival in the wild. It presents a model flowchart highlighting some of the pathways through which factors interact to influence ape distribution and survival. This is further illustrated by charts showing the effects of selected factors on ape abundance in selected countries (based on availability of reliable ape abundance estimates at country level), or rate of change in suitable environmental conditions in range countries.
- **Areas of high ape density and contiguous populations**. Maps showing spatial distribution gradients of ape abundance by region are presented in this section. These are interpolated surfaces generated from site-level population estimates, and relevant for identification of important populations of apes.
- **Site-level ape abundance estimates**. This section presents known ape sites (locations where apes are currently known to exist) by country (for which data are currently available) and population abundance estimates for each site. Here ape abundance is categorized by definition of abundance classes.

BOX 9.1

Map commentary

The maps included in this report combine information from the literature with more recently documented information, with the intention of providing the reader with an overview of the distribution and status of all ape species, across Africa and Asia. The majority of the information presented in these maps is drawn from the Ape Populations, Environments and Surveys (A.P.E.S.) Portal (apesportal.eva.mpg.de). The portal holds some of the most up-to-date spatial and non-spatial information on great apes, either contributed by experts working in the field or obtained by permission from other credible sources (research and conservation institutions and organizations around the world).

The maps show some sites identified in various Regional Action Plans for ape conservation as priority sites for conservation and/or surveys. Given that these regional action plans are collated by experts with the best knowledge of each ape species, information gleaned from them is considered to provide the most accurate information, which reflects the opinions of hundreds of experts and stakeholders.

Caveat

While information presented on the maps is considered highly informative and valuable for ape conservation, it should be noted that gaps do exist.

- Only protected areas categorized under the International Union for Conservation of Nature (IUCN) categories I–IV are shown on the maps. Protected areas with lower/unclassified protection levels are not included for map clarity, and to eliminate the effect of poor quality data in some protected sites.
- Figures on total species abundance presented on the maps are by no means absolute values. These are estimates based on current and past field surveys and in some cases extrapolations based on density estimates at selected sites. Providing absolute values for any population would be highly misleading, but the figures cited on the maps represent the best current estimates.
- Ape geographic ranges do not represent strict boundaries of ape occurrence. While these range boundaries represent the best current representation of ape existence, they may be larger or smaller in some places than current knowledge suggests.

Environmental conditions and great ape survival: models from Africa

Species-level assessment

The suitability of environmental conditions for African great ape survival within their range was recently assessed by Junker *et al.* (2012), constituting the first ever continent-wide model for African apes. This assessment suggests a continent-wide decline in suitable environmental conditions within the geographic range of African apes between the 1990s and 2000s (Figure 9.3).

With an approximately 61.3% loss in the proportion of suitable environmental conditions within its geographic range, the Cross River gorilla (*Gorilla gorilla diehli*) records the highest decline of all ape species studied between the 1990s and the 2000s, while the eastern chimpanzee (*Pan troglodytes schweinfurthii*) records the least decline with less than 1% loss. Other species fall between these extremes. This decline is a result of complex interaction between various human and environmental factors (Junker *et al.*, 2012). For various reasons, however, the direct interpretation of this trend and pattern must be undertaken with caution (see notes in Box 9.2 on p. 260).

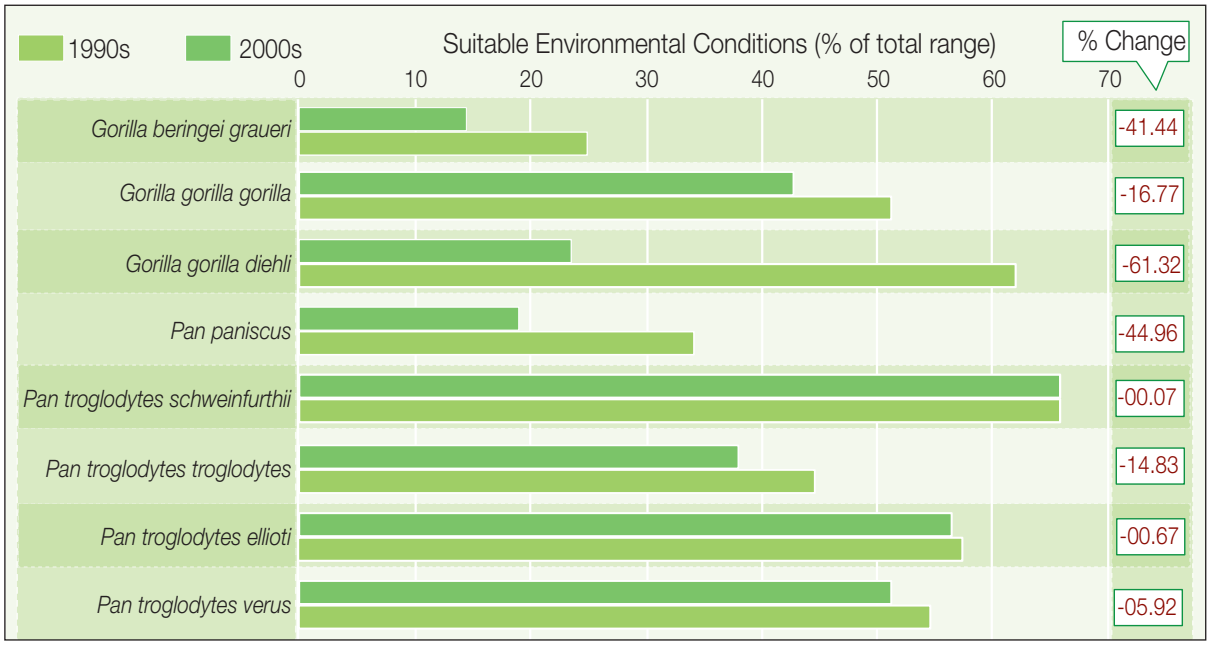
Country-level assessment

In this section, African ape range countries are grouped by three regions: West, Central, and East Africa.

In West Africa, environmental conditions have deteriorated severely in Burkina Faso for *Pan troglodytes verus* by over 70% (Figure 9.4). The chimpanzee is actually suspected to be extinct in this country. Nigeria also presents a case for concern, where the Cross River gorilla appears to have lost over three-quarters of the proportion of suitable

FIGURE 9.3

Suitable Environmental Conditions for African apes at species level (excluding mountain gorillas), expressed as percentage of total range size



Source: Junker *et al.*, 2012.

BOX 9.2

The concept of Suitable Environmental Conditions (SEC)

The concept of Suitable Environmental Conditions (SEC) is used to represent modeled environmental suitability for great ape survival. It uses sophisticated statistical techniques, based on survey data and carefully selected environmental factors that are known or hypothesized to influence ape survival. The results of these models indicate the probability of ape occurrence at every point in space within its range.

SEC is valuable in assessing the availability of potentially suitable habitat for apes. There is a highly complex interaction between factors that affect ape survival, and putting this combination of factors together in sound statistical models is certainly the best way to evaluate their contribution to ape occurrence because it unveils the effect of highly complex interactions between factors, which otherwise would remain unnoticed. An area may be regarded as good habitat with enough food and shelter to theoretically sustain a healthy ape population, but if human pressure such as hunting is high, such an area does not constitute a suitable environment for apes. Therefore the word "environment" describes not only the physical factors within a species' range but also anthropogenic influence and the interactions between them.

The SEC statistics presented here cover all African ape taxa except mountain gorillas. These are the first ever continent-wide models calibrated for apes, and have been peer-reviewed by the scientific community. Data used for this assessment were drawn directly from the IUCN/SSC A.P.E.S. database. For details on the methodology applied and in-depth discussion, see Junker *et al.* (2012). For reasons stated in the original publication, the models were computed with a 100 km buffer outside each ape range (10 km for Cross River gorillas), but for the purpose of this report, statistics have been extracted only within the ape range, excluding this buffer. There are, therefore, slight variations between the figures stated here and those reported by Junker *et al.* SEC models for Asian apes (orangutans) are still in development and not reported in this volume.

Caveat

While results from SEC models contain information relevant to the understanding of ape conservation status, it is important to note that:

- SEC models provide an assessment of environmental conditions (anthropogenic and physical), but do not directly translate to ape abundance. Therefore the SEC percentage stated for each species or country should not in any way or for any reason be interpreted as population size. High environmental suitability does not imply high ape density, but means that there is room for population expansion.
- Like any spatial model, SEC models can be highly affected by various factors such as the spatial resolution at which models are calibrated and predictions made, species range size, and the availability and quality of survey data. Therefore, while these continent-wide statistics are useful for portraying general range-wide trends, results from site-focused analyses will be useful for more detailed, local trends if they are available.

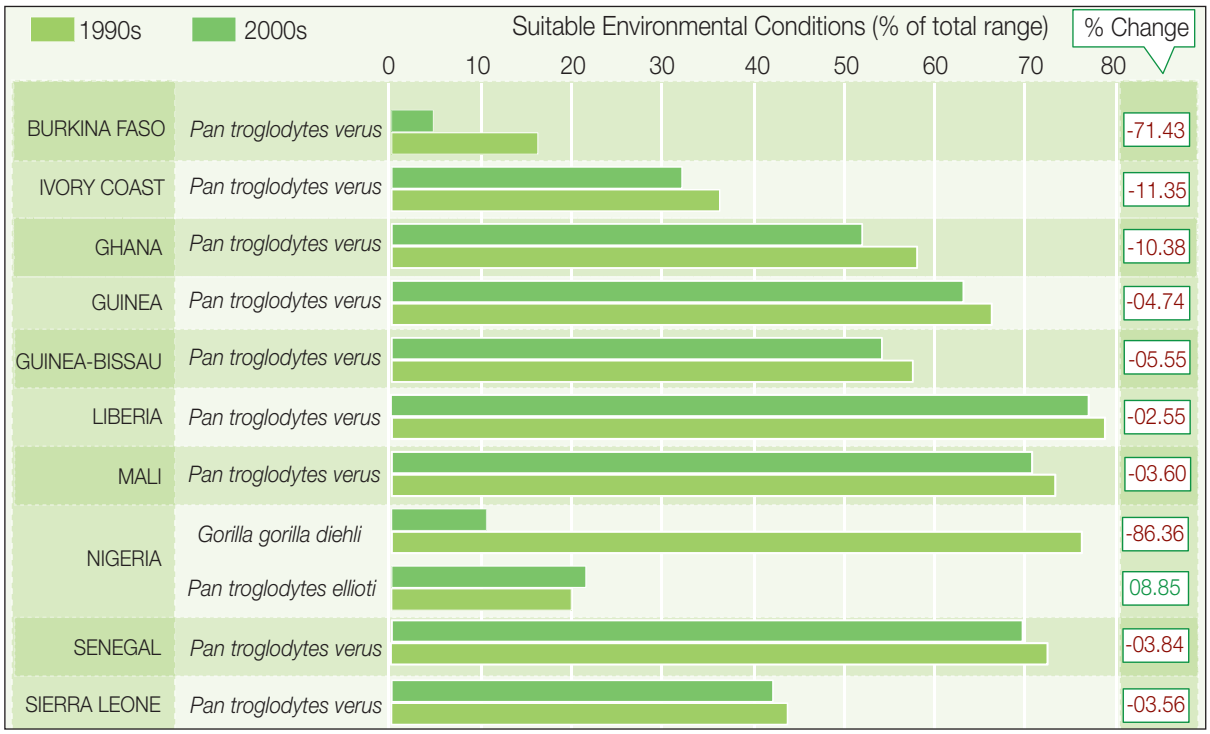
environmental conditions. Interestingly, the Nigeria–Cameroon chimpanzee (*Pan troglodytes ellioti*) has witnessed an increase in SEC in this country, implying that the percentage deficit in SEC for *Pan troglodytes ellioti* presented in Figure 9.3 is accounted for on the Cameroonian side of the range.

Note should be taken of the fact that this is not a reflection of ape abundance, neither is it of habitat occupancy. Many suitable habitat patches are uninhabited, and the connectivity of suitable patches is a very important requirement for ape populations expanding to these uninhabited patches. Ivory Coast for instance records only 11.4% decline in proportion of SEC, but a site-based assessment by Campbell *et al.* (2008b) suggested about 90% decline of chimpanzee population nationwide resulting from various factors, among which human population explosion (about 50% increase between the 1990s and 2000s) and political unrest seem to stand out.

The period between the 1990s and the 2000s witnessed a general decline in SEC in the Central African sub-region (Figure 9.5). Cameroon is one of two African countries where four ape taxa occur – Cross River gorilla, western lowland gorilla, central chimpanzee, and Nigeria–Cameroon chimpanzee. All four subspecies have witnessed a decline in suitable environmental conditions in the country, with highest decline rate recorded for Cross River gorillas. This puts Cameroon in the lead in SEC loss of all countries in the Central African region, with an average SEC loss of over 20%.

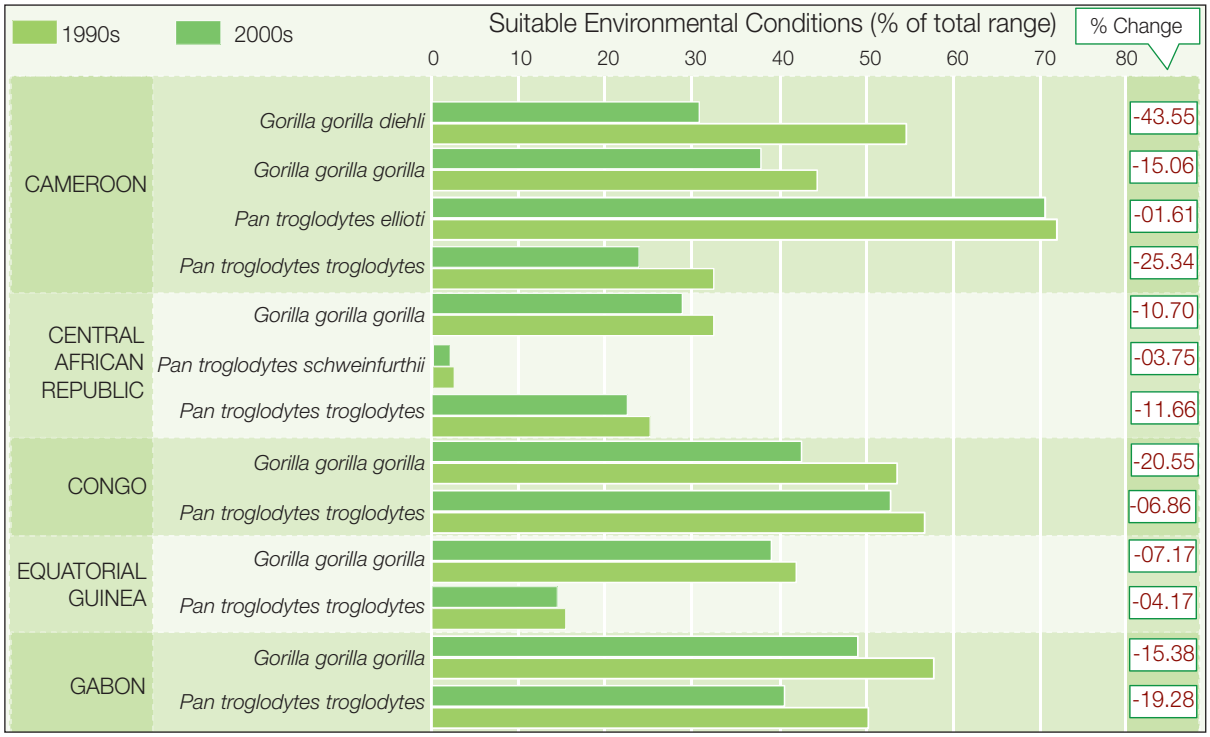
Gabon closely follows Cameroon with approximately 17% mean decline rate in SEC, while Equatorial Guinea records the lowest mean decline rate in the region (5.7%) (likely because in this small, quite densely populated country, conditions were already poor in the 1990s). While there was a slight gain in SEC for the Nigeria–Cameroon chimpanzee on the Nigerian side of its geographic

FIGURE 9.4 SEC for West African apes at country level, by decade



Source: Junker *et al.*, 2012.

FIGURE 9.5 SEC for Central African apes (excluding Angola and DRC) at country level, by decade



Source: Junker *et al.*, 2012.

Photo: Human encroachment into forests is one of the main factors causing wildlife population crashes. © Annette Lanjouw

range, the Cameroonian side accounted for a higher loss, causing an overall decline for the subspecies.

Trend figures from East Africa also show a general decline. However, SEC has been more stable for the eastern chimpanzees (*Pan troglodytes schweinfurthii*) during this period, especially in DRC and Uganda (Figure 9.6). The biggest losses in this region are recorded within the ranges of bonobos (*Pan paniscus*) and Grauer's gorilla (*Gorilla beringei graueri*), both in DRC.

Statistics for Angola, Burundi, Rwanda and central chimpanzees in DRC have been excluded here because those countries contain relatively small areas of great ape range. Given the (coarse) spatial resolution at which the SEC models were computed (500 m resolution), figures in such small areas are most likely to be a result of model error (see Box 9.2 for caveats).

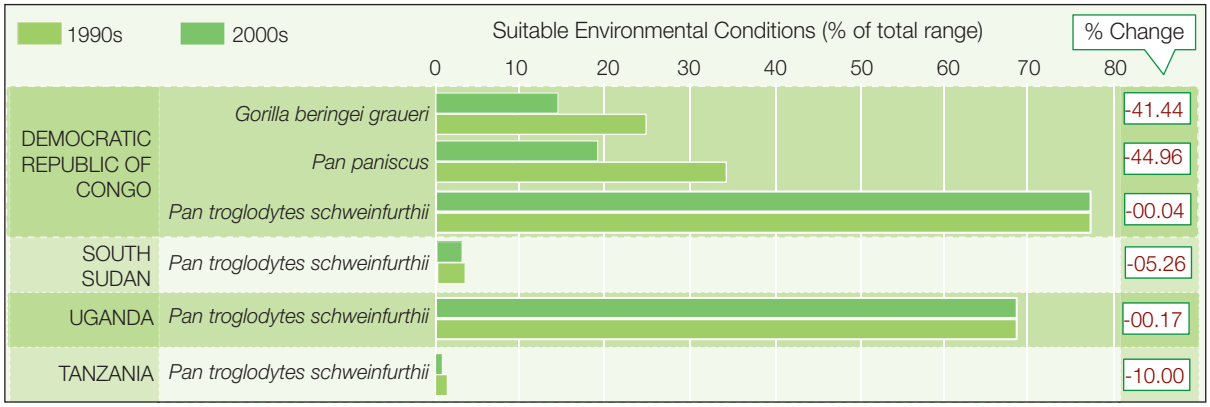
Apes in human-dominated landscapes

Interactions between human and biophysical factors

Human encroachment into forests is one of the main factors causing wildlife population crashes. However, the relationships and interactions between an array of many human and biophysical factors vary over space, taxon, and time. Sometimes just one or two factors are responsible for a reduction in an ape population; for example, the combination of hunting and the Ebola virus in western equatorial Africa almost halved gorilla populations in Gabon (Walsh *et al.*, 2003). Ebola alone killed thousands of gorillas in one area of northern Congo (Bermejo *et al.*, 2006). Factors can, however, be highly complex where, for example, a single factor

FIGURE 9.6

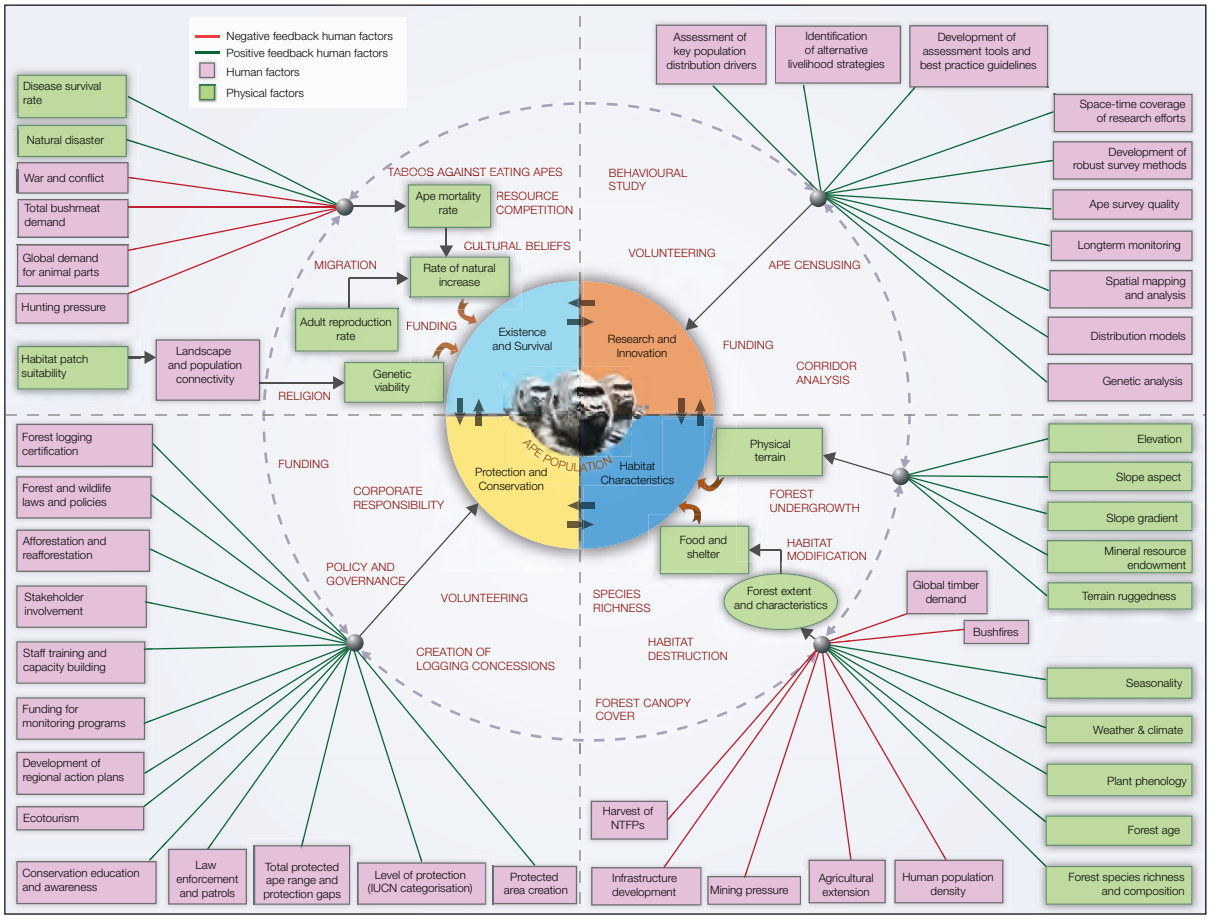
SEC for East African apes at country level, by decade (excluding Burundi, Rwanda and *Gorilla beringei beringei*)



Source: Junker *et al.*, 2012.

FIGURE 9.7

Representation of factors influencing ape abundance



acts through a multitude of pathways or is driven by many other causes. At best, factor effects in such complex scenarios can be estimated through statistical models, and the ability of such models to disentangle these complex relationships and quantify their effects is at the crux of ape conservation planning. Different ape species also possess variable responses to the same magnitude of factor effects, hence the necessity of carrying out assessments at species level.

The complex web of anthropogenic and physical factors working to shape both ape occurrence and abundance can ideally be represented in a simple flowchart (Figure 9.7). These factors are sub-categorized into broader, interrelated themes – *Ape Existence and Survival, Conservation and Protection, Habitat Characterization*, and *Research and Innovation*. In no way is this representative of all factors affecting ape populations, and factor interaction can in some cases form an endless loop. In any case, factors can have negative or positive feedback, and the net balance between the negative and positive determines the size of any given population.

Apes and human activities

In this section, the effects of various anthropogenic factors on ape population and survival are demonstrated through descriptive surface and bubble graphics. In each case, two factors are considered as predictors, while estimated country- or site-level ape abundance, or rate of SEC loss are used as response variables. Considering that variables are computed at the country level and that some ape populations have not been assessed at the country level in most regions, only selected countries for which these data are available are used in plots based on country-level data. However, on a broad scale, the effects of particular variables are expected to be similar across countries, permitting illustrated plots for these selected case studies to be generalized across different ape range countries.

Effects of range protection and range size on ape abundance

Protection of natural habitats is crucial to ape conservation, as it is for most wildlife species. Protection in this case refers to activities aimed at minimizing or eliminating threats to species of flora and/or fauna, while range size is defined as the area of occupancy for each species. Human pressure on natural resources is accelerating globally (see Chapter 1), and like most other wildlife species, apes must compete for space and resources with humans (Gils and Kayijamahe, 2009; Etiendem *et al.*, 2013). Enforcing laws that protect as much ape range as possible directly favors the maintenance, or even growth, of ape population density (Figure 9.8) in the form of reduced human impact (only protected areas under IUCN categories I–IV are considered here). Analyzing the effect of conservation efforts on ape populations across Africa, Tranquilli *et al.* (2012) make a clear case for the need for effective law enforcement. Law enforcement was the best predictor of ape survival above the other conservation factors considered (including research and tourism).

Protecting a natural habitat does not entirely eliminate the impacts of human activities, but if the areas have effective guards, it does reduce the effects. In the forests of Central Africa, where most African apes occur, the probability of human presence decreases with increasing distance from major roads, but is much lower in protected than in unprotected areas (Blake *et al.*, 2007). In the Sumatran region of Indonesia, some of the largest populations of orangutans occur in the Leuser Ecosystem and other protected lands around it, and deforestation is significantly lower in protected areas and up to 10 km of surrounding matrix. In

Viet Nam, the largest contiguous gibbon populations are recorded in protected forests (Rawson *et al.*, 2011). In Borneo, recent studies suggest that about 49% of orangutan range stands the risk of being lost as this proportion lies outside protected lands (Wich *et al.*, 2012b). A recent global study of 60 tropical forest sites showed that effective on-the-ground protection both in parks and in their buffer zones was one of the most important factors in maintaining biodiversity (Laurance *et al.*, 2012). The importance of forest protection and law enforcement to ape population abundance and viability cannot therefore be overemphasized.

Although the existence of protected areas generally has a positive effect on ape abundance, the level or category of protection also matters. The IUCN World Commission on Protected Areas (WCPA) has defined categories for classification of protected areas, taking many factors into consideration. The categories range from one (strictly protected) to level six (less strictly protected) (see Dudley, 2008, for details). The question of whether strict protection yields better results in keeping nature intact over forests managed by local communities is subject to much controversy and debate. Some researchers strongly support the need for strict national laws on protected area management (Terborgh, 1999; Bruner *et al.*, 2001), while others have argued for a more social conservation approach where the socio-economic needs of local people are taken into account (see Chapter 2). Some case studies have demonstrated reduced deforestation and increased nature protection in community-managed forests while sustaining the livelihoods of local people (Olsen and Helles, 2009; Porter-Bolland *et al.*, 2011). However, looking at trends in deforestation, the effectiveness of government and community-based forest management vary by region and continent. For instance, between 2000 and 2010 the highest deforestation rates recorded

Photo: The importance of forest protection and law enforcement to ape population abundance and viability cannot be overemphasized. © Perry van Duijnhoven

in Asia were attributed to expansion in large-scale commercial agriculture, but in Africa the root cause was conversion of forestland to small-scale subsistence agricultural lands by local communities (DeFries *et al.*, 2010; Fisher, 2010; Hansen, Stehman, and Potapov, 2010; Doug *et al.*, 2011). The effectiveness of different types of forest protection should therefore be treated on a case-by-case basis, and in spite of these controversies, one fact remains: any protection is better than no protection at all.

Of course, no factor works in isolation to determine ape abundance. In Figure 9.8, range size is considered in combination with proportion of range protected, and both factors are positively correlated to ape abundance. Therefore, protecting total ape range and preventing range loss and constriction are likely to lead to sustained ape populations.

Trends in West Africa show the relationships between the proportion of range under protection, geographic range size, and human population density (Figure 9.9).

Geographic range sizes in West African countries are generally small, with low rates of protection and high human population density, coinciding with generally low (and decreasing) ape populations nationwide. Nigeria records the highest average human population density within its ape range (*c.* 142 inhabitants/sq. km), and harbors two ape taxa (Nigeria–Cameroon chimpanzee and Cross River gorilla). Ape populations in this country persist in protected areas (national parks and forest reserves). With relatively low human population density in its ape range (*c.* 40 inhabitants/sq. km) and large range size (*c.* 219 532 sq. km), Guinea holds the largest estimated ape population in West Africa (*c.* 10 000 individuals). This population persists despite its lower proportion of protected range. Other factors such as intensive conservation activity, religion, and culture are possibly in play here, but these await assessment.

It is worth noting that in West Africa the majority of ape sites (that is, locations where apes are known to exist) are designated Classified Forests. These are forest areas with legal protection for the trees, but not necessarily for fauna. There has been a rapid

FIGURE 9.8

African ape range protection and ape abundance

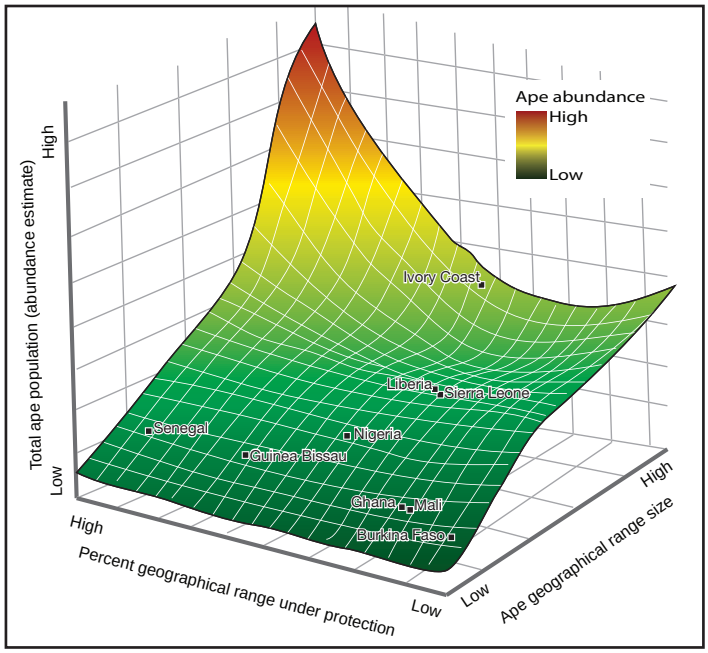
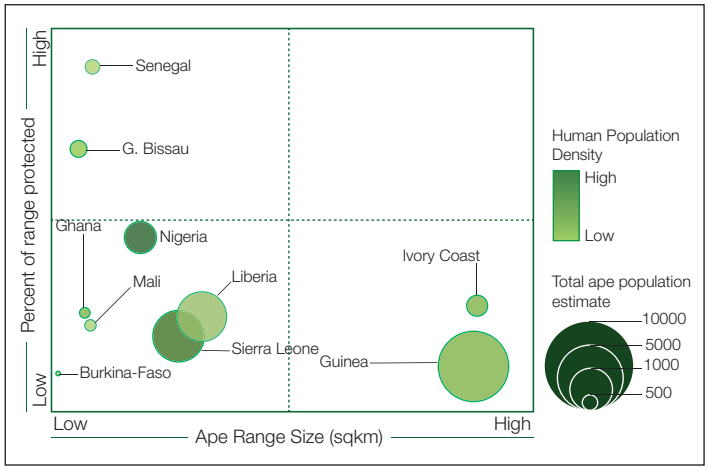


FIGURE 9.9

Ape abundance, range size, percent of range that is protected, and human population density in West Africa



decline in ape numbers across this region, and total extirpation in some of these Classified Forests (Campbell *et al.*, 2008), further highlighting the importance of protection. Given the general importance of protected areas to ape abundance and distribution, it is likely that if current human threats persist, apes will only exist in protected areas in the near future.

While creating more protected areas is without doubt very important for great ape survival, their effectiveness can be compromised by various threats (poaching, illegal logging, agricultural encroachment, artisanal mining, infrastructure development, corruption, etc.). In Viet Nam, the northern white-cheeked gibbon (*Nomascus leucogenys*) is already locally extinct in several protected areas (Rawson *et al.*, 2011), while expansion of oil palm plantations is increasingly taking over protected lands in Malaysia and Indonesia (Buckland, 2005). This suggests, too, that it is not only the existence of protected areas that is crucial, but also addressing and understanding the sociopolitical conditions required for their effective management.

Human economic welfare and ape welfare

The Human Development Index (HDI) is a measure derived by the United Nations Development Programme (UNDP) and is based on various socioeconomic indicators in countries worldwide. Ideally, the HDI can be used as a measure of welfare and prosperity at country level. The index ranges between 0 and 1, signifying lowest–highest, respectively. All apes occur in countries identified by international standards as low-income (poor) economies. Using the HDI as a direct measure of poverty, Gabon, which harbors two ape taxa (*Gorilla gorilla gorilla* and *Pan troglodytes troglodytes*) is the most affluent of all African ape range countries, ranking 106 of 187 countries assessed globally,

TABLE 9.1

HDI values and world ranks (2011) for ape range countries in Africa and Asia

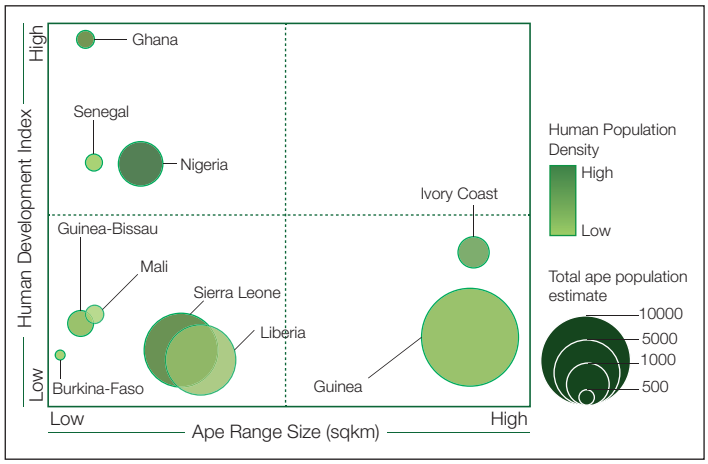
Country	HDI	World rank (out of 187 countries)	Number of ape species
Africa			
Angola	0.486	148	1
Benin	0.436	166	1
Burkina Faso	0.331	181	1
Burundi	0.316	185	1
Cameroon	0.482	150	4
Central African Republic	0.343	179	3
Congo	0.533	137	2
Côte d'Ivoire	0.400	170	1
DRC	0.286	187	4
Equatorial Guinea	0.537	136	2
Gabon	0.674	106	2
Ghana	0.541	135	1
Guinea	0.344	178	1
Guinea-Bissau	0.353	176	1
Liberia	0.329	182	4
Mali	0.359	175	1
Nigeria	0.459	156	2
Rwanda	0.429	166	2
Senegal	0.459	155	1
Sierra Leone	0.336	180	1
South Sudan	n/a*		
Tanzania	0.466	152	1
Togo	0.435	162	0
Uganda	0.446	161	2
Asia			
Brunei	0.838	33	1
Cambodia	0.523	139	3
China	0.687	101	6
India	0.547	134	2
Indonesia	0.617	124	11
Laos	0.524	138	6
Malaysia	0.761	61	6
Myanmar	0.483	149	3
Thailand	0.682	103	4
Viet Nam	0.593	128	6

Note: * South Sudan not ranked on the Human Development Index due to data constraints.

Source: UNDP (2011)

FIGURE 9.10

Ape abundance, range size, HDI, and human population density in West Africa



while DRC, home to four ape taxa (*Gorilla beringei beringei, Gorilla beringei graueri, Pan paniscus, Pan troglodytes schweinfurthii*) is the poorest, ranking 187 globally (Table 9.1). In Asia, except for Malaysia and Brunei, eight ape and gibbon range countries rank above 100 in terms of global HDI.

These statistics clearly indicate that apes occur in landscapes dominated by some of the poorest people in the world. Such poor economies, especially in the humid forested tropics, are ecosystem dependent, with few options except to hunt and gather non-timber forest products for cash income, food, and medicine (FAO, 1995; Falconer, 1996; Ros-Tonen, 1999; Ndumbe, 2010). Unlike some of the extremely poor areas in India,

Photo: Large ranges with low percentage of tree cover are of little use to apes, while high tree cover even amidst relatively small range sizes is more important. © Ian Nichols

where millions of people have been culturally vegetarian for centuries, meat is considered vital for human survival in most of Africa. As domestic meat production is low in much of forested Africa, meat comes from wildlife (and indeed in many languages the words for "animal" and "meat" are one and the same).

In West Africa, the countries with the largest total ape populations (such as Liberia, Sierra Leone, and Guinea) have the lowest HDI (Figure 9.10). However, human population density is relatively low and area of ape occupancy is greater in these countries than in more affluent economies such as Ghana and Senegal.

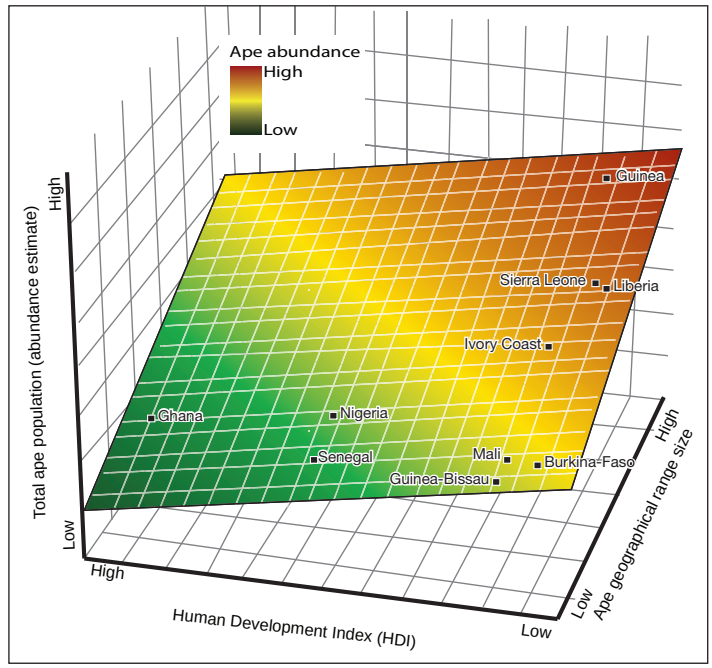
The competition between apes and humans for forest resources and space is one of the driving forces behind other factors that directly affect ape survival. This is particularly true of West Africa and Asia, where small-scale subsistence farming, habitat destruction, and modification remove large areas of suitable forest (especially oil palm plantations in Asia) (Wich *et al.*, 2008).

Figure 9.11 shows an inverse relationship between HDI and ape abundance, showing that most apes occur in poor countries. This is hardly surprising, as apes are essentially tropical species, and most of the worlds' tropical countries are on the low side of the HDI.

The spatial overlap of ape range and poor economies is one reason why conservation practice and planning must be a careful initiative. While maintaining stronger protected areas to keep apes alive is a plausible option (and may be the best option in the midst of rapid ape decline), there is also a need to consider the livelihoods of the local people whose economic lives are rooted in the forest. This is a challenging task for conservationists, and in a bid to alleviate poverty while conserving apes and protecting their habitats, the Poverty and Conservation Learning Group (PCLG) of the International Institute for Environment and

FIGURE 9.11

Relationship between HDI, ape range size, and African ape abundance



Development (IIED) has organized workshops to seek ways to address this issue and promote conservation approaches that integrate economic welfare of local populations at every level possible. In 2010, a workshop focused specifically on great apes was organized in Uganda and followed by a second workshop hosted by the Centre for International Forestry Research (CIFOR) in Indonesia, 2012. Although these workshops drive towards developing best practice guidelines for poverty alleviation in ape conservation and in promoting integrated conservation and development projects (ICDPs), it should be noted that ICDPs are not a novel idea. In fact, ICDPs have been largely criticized for their failure in many cases; (Kiss, 2004; McShane and Newby, 2004; McShane and Wells, 2004). However, this approach may still be valid for countries where there is competition for land between apes and humans. In Central Africa, where land is in use the most common activity is

FIGURE 9.12

Relationship between forest cover, range size, and ape abundance in Africa, computed at country level

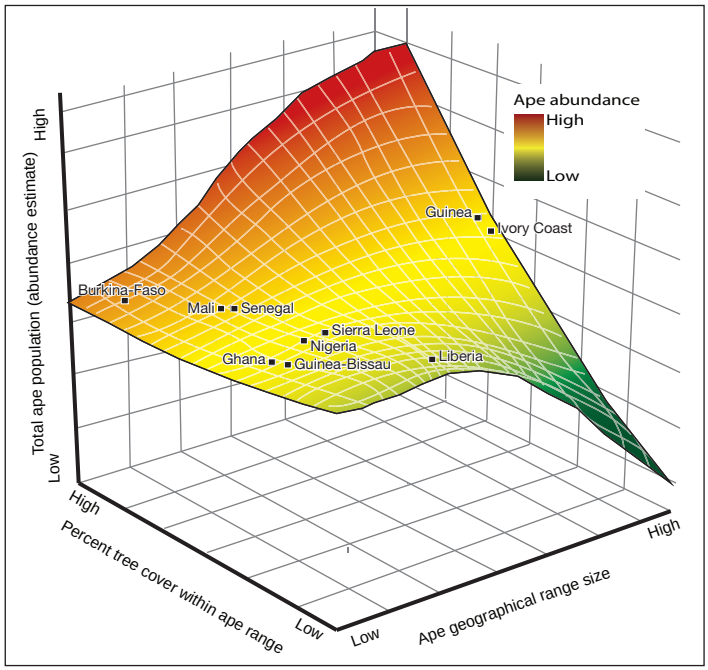
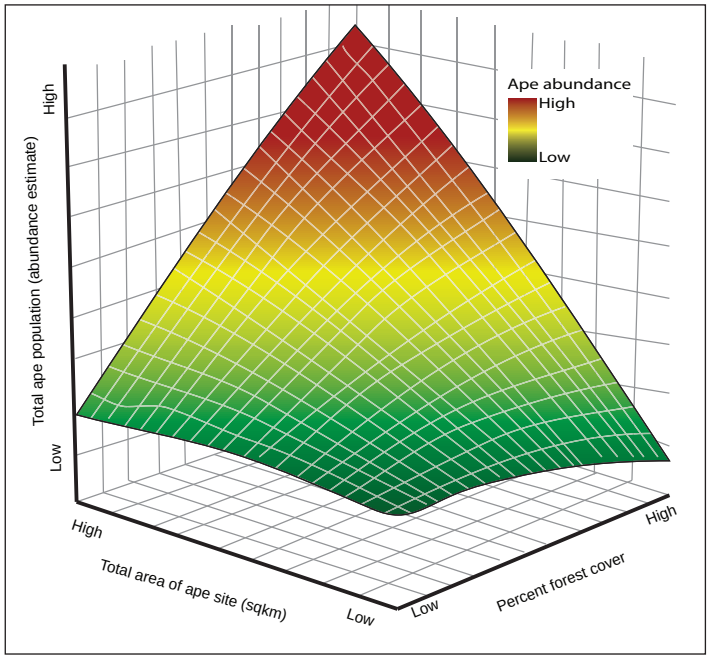


FIGURE 9.13

Relationship between forest cover, range size, and ape abundance in Africa, computed at site level



industrial logging. With appropriate and strictly enforced regulations, including control of hunting, it has been shown that ape survival and reduced impact logging (RIL) can be compatible (Stokes *et al.*, 2010). See Chapter 4 for additional information on this topic.

Effects of forest cover, forest loss, and human population density on ape abundance and survival

Apes are forest dwellers and their existence depends largely on the total extent of forest. Based on country- and site-level statistics from Africa and Asia, Figures 9.12, 9.13, and 9.14 illustrate the strong positive relationship between forest cover, area of ape occupancy, and ape abundance.

Large ranges with low percentage of tree cover are of little use to apes, while high tree cover even amidst relatively small range sizes is more important. This underscores the need to consistently map and update deforestation trends across the entire ape geographic range using robust scientific methods and techniques, such as remote sensing.

Over the past 5000 years, the world is estimated to have lost over 18 million km^2 of forest, yielding approximately 3600 km^2 per year (Williams, 2002). Among the key factors that fuel this destruction, human population growth and increasing demand for and pressure on natural resources are principal drivers (FAO, 2010b). Ape occurrence in Africa and Asia coincides strongly with countries recording some of the highest human population growth rates and population densities in the world. The direct result of this is high loss of forestland owing to expanding agricultural activities, expansion of human settlements, infrastructure development, and logging.

The implication of human encroachment into natural forests on apes is habitat loss

and degradation (see Chapter 7). Figure 9.15 illustrates the combined impacts of growth in human population density and forest loss on rate of decline in suitable environmental conditions for apes in African range countries. It should be noted that the two countries (Congo and Gabon) harboring most of the worlds' gorillas and central chimpanzees, and the country (DRC) with all of the bonobos, probably most of the eastern chimpanzees, and all the Grauer's gorillas, have extremely low rates of forest loss (Figure 9.15).

In figures 9.4–9.6, we presented country-level statistics of decline in SEC between the 1990s and 2000s. Two of the important variables that defined SEC for almost all ape taxa were human population density and the Human Influence Index (HII). The latter is essentially an amalgam of several different spatially explicit human factors, including roads, human density, settlements, and global lights (WCS/CIESIN, 2005). Thus, as human populations grow and/or forest is increasingly lost, SEC for apes will be further reduced. High human population density may also increase the risk of infectious disease transmission between humans and apes.

Open issues

There still exist gaps in current knowledge of how apes survive in the wild amidst human influence, and how effective current protective measures are in maintaining long-term population survival. This chapter therefore serves as a pointer to some of the open issues pertaining to ape conservation.

Effectiveness of local community forests and government-protected areas

In areas where local communities have claims to areas that harbor apes, it is important to determine whether or not community forests are more effective in protecting natural areas than strict, government-designated protected areas, and whether a top-down approach to protected area management works better

FIGURE 9.14

Percent tree cover, ape range size, human population density, and ape abundance in West Africa

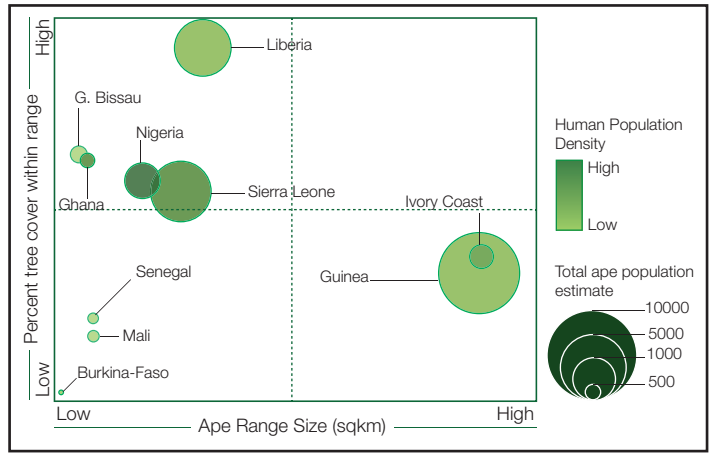
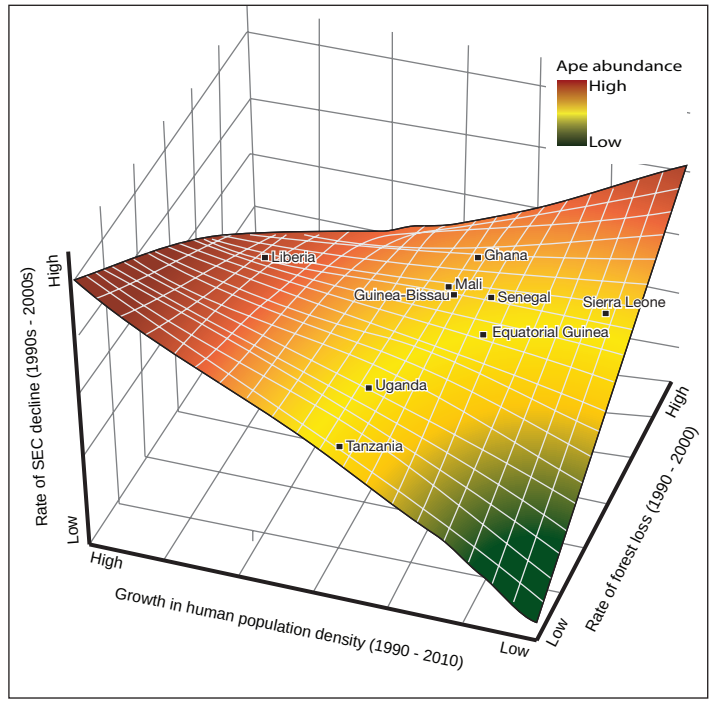


FIGURE 9.15

Human population density, rate of forest loss, and SEC for African apes



than a bottom-up approach (Naughton, 1993; Malla, Neupane, and Branney, 2003; Gibson, Williams, and Ostrom, 2005; Hayes and Wagner, 2008; Gibson *et al.*, 2011). Despite different arguments and views, there is currently no statistically measured and quantified study addressing this issue. The opposing views presented in current research seem to suggest that this issue needs to be addressed on a case-by-case basis, but rigorous statistical measurements need to be carried out to quantify the effects of different protection categories on ape existence and survival. In terms of a more general approach, a review of over 60 alternative livelihood community projects in Africa, including an in-depth review of 15 of them, was unable to find compelling evidence of conservation success (Wicander and Coad, 2013).

Photo: Gaps still exist in the current knowledge of how apes survive in the wild amidst human influence, and how effective current protective measures are in maintaining long-term population survival.
© Zhao Chao

Assessment of different type of governance

The type of governance that is put in place to manage conservation areas is crucial to the effectiveness of conservation efforts. A governance system that diffuses authority to multiple institutions (polycentric governance) will have different management effects than a system where authority is consolidated to a single or limited number of bodies. If, hypothetically, a single organization is in charge of a highly important conservation site, management of the site will become ineffective if the organization decides, for any reason, to withdraw from the site. A polycentric system of management may potentially also make local governments and other actors feel involved in the conservation process, but at the same time runs the risk of misalignment of responsibilities between the various stakeholders for management of the area and implementation of the laws. This is an open issue waiting to be addressed through in-depth field research.

Global indicators of threats and conservation status

In order to keep track of trends in ape populations and threat levels, it is important to develop standard statistical indicators of ape conservation status and threats to their survival. This could involve the computation of Ecological Index Scores at site and country levels, using a combination of relevant factors, including conservation effort, research coverage, sign encounter rates, species richness, and SEC. Such indicators will be valuable for assessing temporal trends in ape conservation.

Active contribution to the A.P.E.S. Portal

The A.P.E.S. Portal project is one recent step towards long-term conservation and moni-

toring of ape populations throughout the world. Developed by the Department of Primatology at the Max Planck Institute for Evolutionary Anthropology (MPI-EVA), A.P.E.S. is a collaboration between the IUCN/SSC Primate Specialist Group (PSG), the Jane Goodall Institute, the United Nations Environment Programme World Conservation Monitoring Centre (UNEP-WCMC), and numerous other organizations/institutions involved in ape conservation and research. The Portal is a one-stop website where the most up-to-date information about great ape status and conservation is cataloged. It also provides a centralized platform for great ape survey data collected in Africa and Asia over the last 20 years, as well as valuable contextual information and tools relevant for ape conservation. Currently, this platform houses limited information on the small apes; however, it is a work in progress. The long-term usefulness of the Portal depends on the active participation and continued contribution by different actors involved in ape conservation around the world, in providing new survey data, site population estimates, information on existing research and conservation sites, and using the dashboard and other tools provided for conservation planning.

Ape abundance: population concentrations and largest contiguous populations

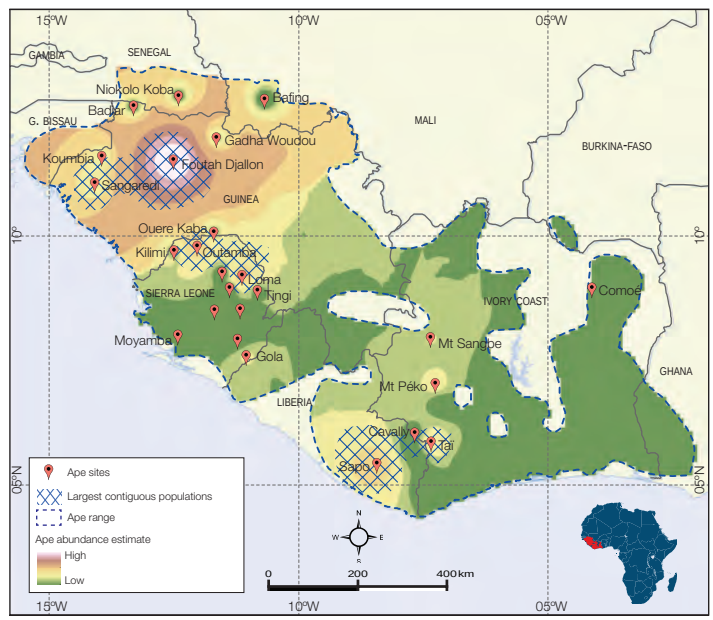
Ape population concentrations are identifiable by applying basic spatial interpolation[1] methods to site location and ape population estimates at each site. Whether or not a site can be considered a population concentration is contingent on its total ape population as well as on its proximity to other ape sites. Through site-level population estimates, large potentially contiguous populations can be mapped, and identifying such concentrations and contiguous populations is crucial for site prioritization, creation of conservation landscapes and conservation/research resource allocation. While such concentrations are presented below, it is worth noting that they are based on currently available site abundance estimates (total number of apes estimated for each site). If there were no data gaps, it is possible that the trends would differ slightly from those presented in this section.

Ape abundance in West Africa

Alarming decline rates in ape populations in West Africa have been reported over the past decade (Campbell *et al.*, 2008b), suggesting that firm conservation measures need to be taken to protect the remaining populations. Recent estimates suggest that the Foutah Djallon region of Guinea supports the largest remaining western chimpanzee population (see Annex IV, Table 2),

FIGURE 9.16

Ape population abundance in West Africa



while the population gradient decreases towards the eastern part of their geographic range (Figure 9.16).

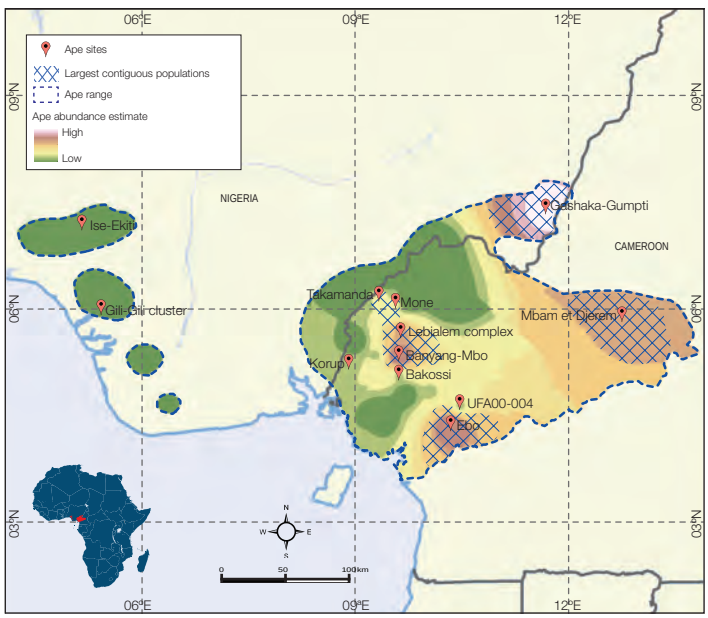
Amidst this general pattern, some large contiguous populations are identifiable, such as Foutah Djallon-Koumbia-Sangaredi, Outamba-Kilimi-Loma Mountains, and Sapo-Grebo-Taï. These regions coincide with the efforts of the Wild Chimpanzee Foundation (WCF) to protect apes and their habitats, in collaboration with local organizations and mining companies. Mont Peko and Mont Sângbé in Ivory Coast and Gola in Sierra Leone also constitute western chimpanzee population concentrations.

Ape abundance in the Nigeria–Cameroon sub-region

Cameroon and Nigeria host two ape taxa: the Nigeria–Cameroon chimpanzee (*Pan troglodytes ellioti*) and the Cross River gorilla (*Gorilla gorilla diehli*). The total ape population for each site is the sum of populations for both subspecies. The isolation of ape populations in this region is glaringly depicted in Figure 9.17.

FIGURE 9.17

Ape population abundance in Nigeria–Cameroon



The high–low distribution of ape populations in Nigeria and Cameroon follows an east–west gradient, with especially small site-level populations in Nigeria, which also contains a relatively small percentage of ape geographic range. The large contiguous populations identifiable are the Ebo Complex; Gashaka-Gumti and neighboring forests; the Lebialem Complex-Banyang Mbo; Mbam and Djerem and neighboring forests northwest of the Sanaga River; and Takamanda-Mone-Mbulu. Working closely with organizations such as San Diego Zoo Institute for Conservation Research and World Wildlife Fund (WWF), the Wildlife Conservation Society (WCS) has been carrying out research and conservation in this region since 1988.

Ape abundance in western equatorial Africa

Western equatorial Africa covers five countries in the Central African sub-region – Cameroon, Central African Republic (CAR), Congo, Gabon, and Equatorial Guinea (here we exclude Angola because it contains a relatively small area of ape range). Two ape subspecies are found in this area – the central chimpanzee and the western lowland gorilla.

Ape populations at known ape sites in this region are generally much larger than in other parts of Africa, but they face severe hunting pressure, a greater likelihood of Ebola virus outbreaks and, in the next decade, habitat loss due to expanding industrial agriculture is a very real possibility. Gabon and Congo support the largest ape populations in Africa (Figure 9.18).

Here, very large potentially contiguous populations cut across vast landscapes, such

as Lopé-Waka in Gabon, and the Odzala National Park which is contiguous with Ngombe and other surrounding logging concessions (Pikounda, Ntokou) in Congo. Another contiguous block is found on the east side of the Sangha River, where ape populations in Dzanga-Sangha National Park, Nouabalé-Ndoki National Park, and Lac Télé Community Reserve are connected by selectively logged timber concessions.

The maintenance of such large ape populations in forest concessions indicates that with good management and planning, apes can survive amidst industrial extraction of forest resources (Stokes *et al.*, 2010; Maisels *et al.*, 2012). See chapters 4, 5, and 6 for more information in relation to the different extractive industries.

A vast area of ape range in western equatorial Africa, cutting across Gabon and Congo, was struck by an Ebola virus outbreak in 1994, which is estimated to have wiped out approximately 90% of western lowland gorillas in northern Congo and Gabon (Walsh *et al.*, 2003; Bermejo *et al.*, 2006). WCS and WWF, in partnership with a number of local and international organizations and research institutes, run strong conservation programs in this region, protecting ape habitat to sustain healthy populations of wildlife.

Ape abundance in East Africa (including DRC)

Four ape taxa are found in East Africa: bonobos (*Pan paniscus*), one chimpanzee subspecies (*Pan t. schweinfurthii*), and two eastern gorilla subspecies (*Gorilla b. beringei* and *Gorilla b. graueri*).

The region stretching from Bili-Uere to the Okapi Reserve in DRC harbors some of the largest remaining eastern chimpanzee populations (Figure 9.19). The largest bonobo populations have been recorded in Salonga National Park (both northern and southern sectors); this taxon occurs in DRC only. Many conservation organizations and research bodies are active in this region.

FIGURE 9.18

Ape population abundance in western equatorial Africa

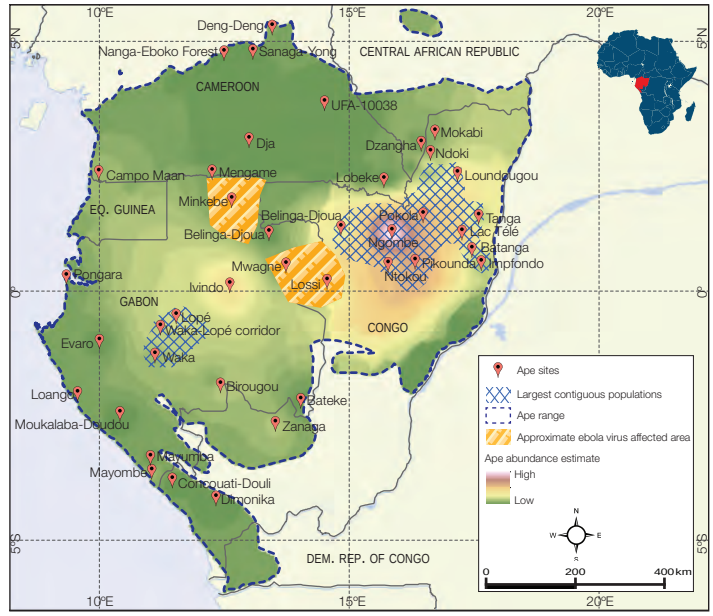
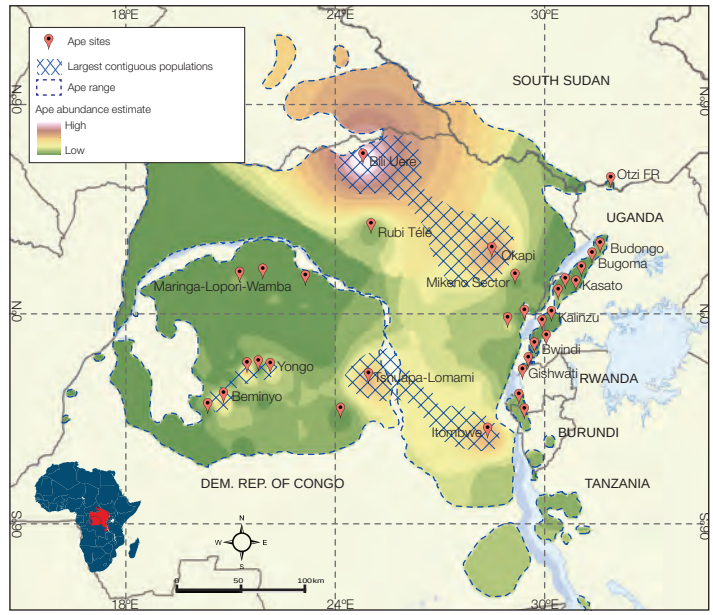


FIGURE 9.19

Ape population abundance in East Africa



Ape abundance in Borneo (Southeast Asia)

Figure 9.20 shows great apes (Bornean orangutans), but not small apes (gibbons) due to the current scarcity of data for this Family in the IUCN/SSC A.P.E.S. database. Extensive data collection is on-going and will be presented in subsequent editions of *State of the Apes*. Three orangutan subspecies occur on the Bornean island of Indonesia, Malaysia, and Brunei. The largest populations occur in the southwestern part of the island: the region stretching from Tanjung Puting through Sebangau to Mawas harbors a large orangutan population. Other notably large populations are found in Gunung Palung-Arut Belantikan, the Kelai watershed (including Gunung Gajah, Wehea, and many logging concessions), and Tabin-Segama in the northeast.

FIGURE 9.20 Ape population abundance in Borneo

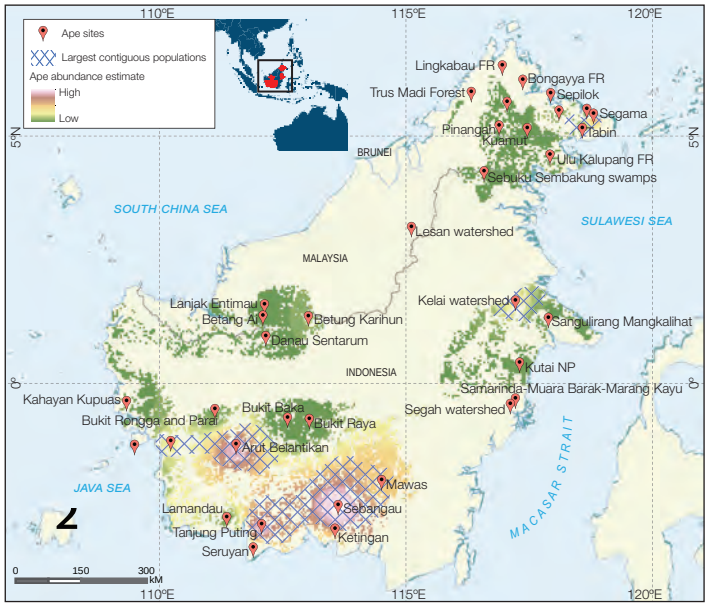
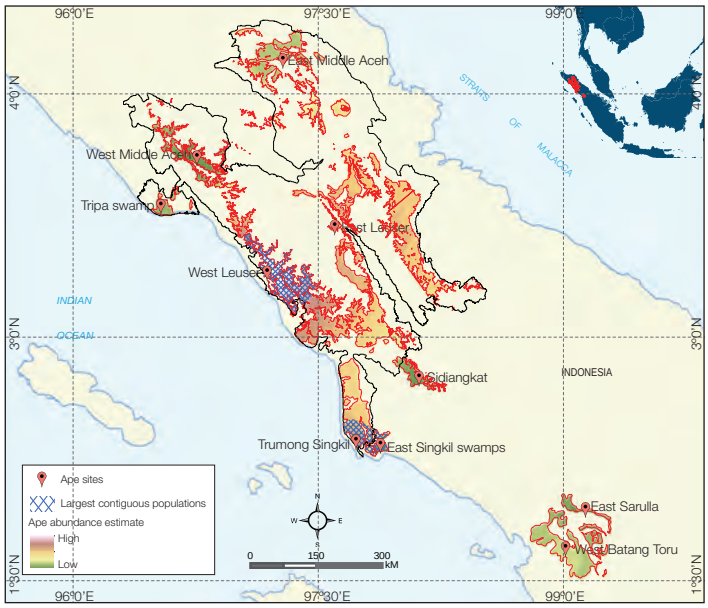


FIGURE 9.21 Ape population abundance in Sumatra



Based on Wich *et al.*, 2012b

Ape abundance in Sumatra (Southeast Asia)

There remain an estimated 6660 Sumatran orangutans (*Pongo abelii*) on the Indonesian island of Sumatra (Wich *et al.*, 2008). This species is mostly located within the protected Leuser Ecosystem in the province of North Sumatra and Aceh (Figure 9.21). A smaller population exists further south, in the forests of West Batang Toru and East Sarulla. Surveys show that the largest surviving populations (> 1500 individuals) are in West Leuser and Trumon-Singkil, but they face high levels of threat from humans. Conservation and research efforts are active throughout the Sumatran orangutan range, led by the Sumatran Orangutan Conservation Programme (SOCP), a partnership of four organizations – Directorate General of Forest Protection and Nature Conservation (PHKA), PanEco Foundation, Yayasan Ecosistem Lestari, and Frankfurt Zoological Society – in collaboration with several academic institutes.

Ape abundance estimates

Ape abundance estimates at site level, where "site" is a protected area and its buffer zone,

or a logging concession or group of concessions, or any discrete area where a survey has taken place in the last two decades (a few sites were last surveyed in the 1980s), are presented in Annex IV, available on the State of the Apes website: www.stateoftheapes.org. The list of ape sites in the Annex is not in any way exhaustive and updates (to both sites and survey data) will be made available in digital format via the A.P.E.S. Portal.

Conclusion

- This chapter summarizes current knowledge of the status of ape populations. The information presented reveals the gaps in our knowledge of great ape distribution, abundance, and population trends. It is hoped that these will be filled in the coming years and complemented with additional data on small ape populations.
- The majority of all ape populations are found in forested areas. Effectively protected areas generally have a positive effect on maintaining ape abundance; however, the level or category of protection is also important. Range size must be considered in combination with proportion of range protected, and both factors correlate positively with ape abundance.
- The proportion of ape populations found outside the system of protected areas is a cause for concern. This highlights that effective conservation of apes not only requires the establishment and maintenance of protected areas, but also involves understanding and addressing the sociopolitical conditions required for the effective management of both protected areas and the unprotected matrix in which so many apes still occur.
- Apes in Southeast Asia and West Africa occur in landscapes dominated by some of the world's poorest people and the competition between apes and humans for space and resources is one of the driving forces behind other factors that directly affect ape survival. This competition between apes and poor people needs to be taken into account in planning ape conservation strategies/initiatives.
- The effectiveness of community-managed forests in comparison with government-protected areas is a subject of much debate and is beyond the scope of this report; rigorous testing of the validity of these approaches is clearly overdue.
- Most African apes live in the vast, relatively intact forests of Central Africa, where there is no competition for resources between humans and apes, because the human population density is very low.

Conservationists, researchers, and industry environment programs are encouraged to engage with the A.P.E.S. project by contributing data on ape abundance, distribution, and changes in land use (if available), to contribute to both conservation planning and practice.

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Endnotes

1 Spatial interpolation is a statistical procedure for estimating values for unsampled locations or sites based on values of known sites.