INDEX

A
Ankylostoma spp. 283 Anopheles mosquitoes 30, 31, 283; see also malaria anthelmintic treatments 32, 124–125 anthrax 19–20, 89, 277 antibiotics 16, 17, 18, 20, 31, 69, 70, 115, 125, 155 antibodies 32, 33, 34, 36, 94, 126 ape disease and health, review of 10–15, 40–41, 276–287 captive apes, infectious diseases in 30–36 captive apes, non-infectious diseases in 36–40 key findings 15 sampling 29 wild apes, infectious diseases in 15–28 wild apes, non-infectious disease in 28, 30 Ape Heart Project (Twycross Zoo) 39, 71 arboreal locomotion 89, 205, 209, 255, 257, 317 Ascaris spp. 283 Asian apes see gibbons (Hylobatidae); orangutans (Pongo spp.)

B
Bornean gray gibbon (*Hylobates funereus*) xviii, xxii, xxvi–xxvii, 73; see also gibbons (Hylobatidae); *Nomascus* gibbons
Candidatus *Sarcina troglodytae* 278
canine bridges 30, 209, 221
Cantanhez National Park, Guinea-Bissau 18
Cao Vit gibbon (*Nomascus nasutus*) xviii, xxiii, xxvi–xxvii, 299; see also gibbons (Hylobatidae);
*Borneo; see also* Indonesia
Captive ape welfare 233–261
assessing 199, 235–236, 248–254, 261, 310–313
balancing benefits/risks 156–158
Barber and Mellen welfare infrastructure 238
barriers and challenges 247–248, 250, 260, 305–309
Brando and Buchanan-Smith 24/7 framework 236
defining animal welfare 199, 234, 235
closure designs 237, 240, 254, 255–257, 260
economics of ape care 151, 156–158
Five Domains Model 199, 235–236, 250
key findings 234–235
language 236, 237, 259
movement between facilities 233, 236, 238
public concern for 233, 236, 260–261
standards of practice
failure to promote good welfare 247–248, 250
internationally developed standards 245–246, 259–260, 308–309
international conventions and declarations 241–244, 259
national legislation and regulations 240–241, 259, 303–304
professional associations and accreditation 244, 259, 304, 307
for rehabilitation and release 246–247
welfare continuum 236
captive apes, status and number of 261–271
Africa 261–264
Asia 264–267
data limitations 270–271
Europe 267–268
key findings 235
Latin America 268
Oceania 269
overview 261
United States 269–270
captive/semi-captive settings; see also captive ape welfare; captive apes, status and number of;
specific type of setting
accreditation 235, 238, 244, 259, 304, 307
ape health interventions 112–114
API scores 261–262, 264–265
“captive facilities” defined 233, 318
disaster management 168–170, 178, 186, 190, 195
disease prevention strategies
anthelmintic treatments 32
| best management practices (BMPs) | 99 |
| biosafety practices | 32 |
| enclosure designs | 26, 30, 52 |
| foraging-like “work” | 37 |
| good hygiene | 26, 36 |
| monitoring | 26, 94 |
| nutritional management | 36–37 |
| One Health approach | 52, 69–70 |
| plastic bans | 100 |
| quarantine | 26 |
| staff health | 26, 27 |
| staff PPE use | 26, 27 |
| strict standard operating procedures (SOPs) | 94 |
| UK Framework for Preventive Health Programming and Interventions | 131–132 |
| vaccination | 25, 126, 127 |

**Disease Risk Factors**

- diets | 32 |
- disease reservoir population densities | 31, 36 |
- gut microbiome disturbances | 31, 69 |
- human–ape interactions | 4–5, 6, 30, 78, 79, 80, 92–95, 96–97, 114 |
- for illegally-trafficked apes | 123–125 |
- malnutrition | 6, 37 |
- old age | 6, 38–40 |
- other animals–ape interactions | 4–5, 6, 31, 34 |
- plastics | 100 |
- poor enclosure designs | 94 |
- poor management | 94, 95 |
- poor ventilation | 35 |
- population density | 30, 31, 32, 35 |
- small cages | 35 |
- stress | 6, 30, 32, 40, 70, 83, 106, 158 |
- substandard hygiene | 31 |
- diseases/conditions in | 30–40, 276–287;  see also specific condition; specific disease |
- ethics of ape care | 151, 156–158 |
- habitation | 78, 79, 82–83 |
- illegal captivity | 40, 94, 96, 123–125, 267, 284;  see also trafficking, wild animal |
- indoor versus outdoor settings | 83 |
- sampling/testing | 29, 69–70, 137–138 |
- as tourist destinations | 80 |
- welfare see captive ape welfare |
- cardiologists | 71, 318 |
- cardiomyopathy | 37, 38, 71, 318 |
- cardiovascular disease | 37, 38–39, 70, 71, 122, 277, 285, 318 |
- Central African Republic | 19, 25, 89–90, 221–224, 226 |
- central chimpanzee (Pan troglodytes troglodytes) | xiv, xxi, xxiv–xxv, xxviii, 22, 24, 221–222, 298;  see also chimpanzees (Pan troglodytes) |
- certification schemes | 181, 202, 208, 215–218, 223, 226;  see also accreditation of captive facilities |
- cestodes | 32, 33 |
- chimpanzees (Pan troglodytes); see also specific subspecies |
- anthrax | 19, 20 |
- behavioral and ecological characteristics | 204, 205 |
- behavioral studies, landmark | 115, 116 |
- cardiovascular disease | 37, 38, 71 |
- CITES and IUCN listing | xiv, xxi |
- climate change impacts | 164 |
- COVID-19 | 278 |
- dental disease | 40 |
- diet | xv, xxviii, xxix, 205 |
- disease transmission to/from humans | 12, 90, 91, 288 |
- distribution | xiv, xx, xxi, xxiv–xxv |
- Ebola virus | 12, 21, 22, 137, 151 |
- epizootic neurologic and gastroenteric syndrome (ENGS) | 34, 278 |
- facial dysplasia | 30, 287 |
- gastrointestinal parasites | 32, 33 |
- habitat types | xxviii, 204, 205 |
- habituation | 81, 88, 90, 91 |
- health interventions | 117, 118, 153–156, 156–158 |
- hepatitis A | 279 |
- hepatitis B | 279 |
- HIV-1 group M | 12 |
- home and day ranges | xxix–xxx, xxxi |
- human coronavirus OC43 | 288 |
- in human environments | 2–3 |
- human metapneumovirus (HMPV) | 288 |
- human orthopneumoviruses | 288 |
- human respirovirus 3 | 288 |
- human rhinovirus C | 288 |
- hunting other mammals | 12 |
- in illegal captivity | 238 |
- industrial impacts and mitigations | 209, 210, 214, 298 |
- leprosy | 12, 18 |
- life expectancy | xv |
- locomotion | 205, 208 |
- malaria | 30 |
- meliodosis | 36 |
- monkeypox virus (MPXV) | 10–11, 16, 36 |
- nesting | xxxi |
- numbers | xiv–xxv |
- numbers in captive settings | 262, 263–264, 265, 266, 267, 268, 269, 270 |
- overview | xiv–xxv |
- pesticide poisoning | 287 |
- physiology | xv |
- polio | 117, 151 |
- poliomyelitis | 281 |
- renal disease | 39 |
- reproduction | xxxi, xxxii, xxxiii |
- respiratory diseases | 25, 26–27, 28, 34, 35, 90, 91, 102 |
- sarcoptic mange (scabies) | 16 |
simian immunodeficiency viruses (SIVs) 24–25, 281
snare injuries 117, 153–156
social organization xv, xx, xxii, 12, 205
socioecology xx–xxxiii
species xxi
stress in captive settings 83
territoriality 205
threats to xv
vaccinations 117, 126–127, 151
vocalizations 103
yaws (TPE) 12, 17
China 264–265, 298, 299
chlorpyrifos 30, 287, 318
circuses, animal use in 267
Clostridium tetani 278, 282
colitis 32, 33, 69, 135, 282, 318
collectivism 147, 148, 321
“common cold” (human rhinovirus C) 13, 25, 278, 288
communities, local
conflicts with apes 78, 89, 118
COVID-19 impacts 87, 99, 174, 176, 181, 264
education and awareness programs 45, 48, 56, 60, 65
engagement with 48, 66
health initiatives 53, 55–60, 62, 64–65, 67–68, 86, 97, 137
investing in 45, 59, 60, 178
involvement in conservation 60, 62, 70, 73, 86, 133, 149–150, 178, 226
tourism benefits/costs 85–86
compassion fatigue 159–160, 326
compassionate conservation 7–8, 144, 146, 147–150, 152, 160, 236, 318
compounding risks 174–177, 318
Congo Basin 221–224
conjunctivitis 94
Conservation, Mitigation and Biodiversity Offsets in Africa (COMBO) program 214, 230
conservation litigation 241, 318
Coronaviridae 288
COVID-19
in apes 278
causative pathogen 7, 45
gorillas, risk to 35–36, 60, 181, 186
impacts on ape rescue centers 171
impacts on ape tourism and research 87, 98, 174–176, 181, 264, 270
impacts on conservation 87, 99, 174, 176, 264
impacts on local communities 87, 99, 174, 176, 181, 264
impacts on understanding of animal welfare 259
impacts on zoos 269
minimizing transmission risks 60, 87, 97–98, 130, 171, 209–210
Non Human Primate COVID-19 Information Hub 66
preparedness documents 185
recognition as global problem 3, 45, 50
complaining 32, 282, 318
crop-raiding 30, 68, 78, 86, 89, 120
Cross River gorilla (Gorilla gorilla diehli) xv, xxi, xxiv–xxv, 209; see also gorillas (Gorilla spp.); western gorillas (Gorilla gorilla)
cross-reactivity 24, 114, 319
Cryptosporidium spp. 32
cumulative welfare assessment score (CWAS) 310
cysticercosis 33
cytomegalovirus (CMV) 33, 124, 152, 319

D
data mining 187–188, 319
DDT/pp-DDE 30, 287
deciduous teeth 39, 277, 319
deficiencies and imbalances, nutritional 37, 40
deforestation 53, 54–55, 61–62, 66, 88, 102, 112, 113, 150, 216; see also habitat loss/fragmentation/degradation; logging
Delphi method 251, 252
Democratic Republic of Congo (DRC)
behavioral studies, landmark 116
climate change impacts 171, 172–173
community engagement 68, 137
COVID-19 impacts 174–177, 181
diseases in apes 17, 19, 21, 22, 25, 94, 137
Gorilla Doctors 62–65, 115
Gorilla Rehabilitation and Conservation Education Center (GRACE) 199, 257–258
Great Ape Welfare Index (GAWI) trials 311
Greater Virunga Transboundary Collaboration 176, 178, 185, 186–187, 188
habituation 89–90
logging 298
mining 299
numbers of apes in sanctuaries 263, 264
tourism 84, 85, 174–177
dental disease/issues 38, 39–40, 277, 285
dependency, alcohol/drug/tobacco 40, 284
depigmentation, skin 18, 280, 319
dermatophytes 125, 319
diabetes 39
diagnostic protocols 114, 319
diagnostics see sampling/testing
Dientamoeba fragilis 282
diet xiv, xv, xvi, xvii–xviii, xix, xxii, xxviii–xxix, 36–37, 171, 205
Dirofilaria immitis 282
disaster impacts; see also COVID-19
climate change hazards 167, 168–170, 171
direct impacts 166–167
indirect impacts 167
multiple threats 162–164, 165, 167
stages 166–167
terminology 166
wildlife coping strategies 171–172, 172–173
disaster management; see also risk assessments
best practice guidelines 195–196
capacity and capability 184–185, 296
case studies 168–170, 174–176
command and control systems 182, 186, 191, 195, 196, 318
community engagement 192–193
compounding risks 174–177, 318
contingency plans 185–186
continuum of 178, 185–186
cost–benefit analysis 174–177
costs, financial 318
documentation 185–186, 296
eyeary warning systems 188–189
governance 186–187
key findings 164–166
management systems 187–190, 297
monitoring and review 193–195
multi-agency response 323
Ngamba Island flood crisis 104–105, 168–170, 294–297
PEESTOLM approach 164, 172, 174
preparedness see preparedness, disaster prevention
178–181, 295–296
recovery 191–192
responses 190–191
risk management 172–177
risk mitigation 177–178
terminology 166
usage exercises 190, 297
volunteers, management of 191
disease ecology in natural habitats 102–103
disease emergence 48, 52, 101, 102, 150, 319
disease/injury prevention strategies; see also interventions, ape health; One Health strategy
best management practices (BMPs) 64, 91, 97–100
biosafety practices 32, 107, 124, 133, 317–318
biosecurity practices 68, 131, 181, 189, 318
canopy bridges 30, 209, 221
in captive/semit-captive settings see captive/semit-captive settings, disease prevention strategies
containment actions 191
distancing measures 60, 87, 91, 99, 103, 105, 176, 181
everly warning systems 102, 137, 188–189, 191
education and public awareness 26, 48, 62, 64–65, 95, 99–100, 137, 180
employee health programs 28, 62, 64–65, 131
field laboratories 28
improved hygiene 26, 28, 36, 60
improving human health 28, 48, 53, 64–65; see also One Health strategy
integrated approaches 46–47, 110, 111
legislation and regulations 95, 100
multipronged approach 106–107
overview 26
pathogen surveillance 36
PPE use 26, 27, 176
primary prevention 144, 150, 324
quarantines 26, 28, 34, 87, 91, 99, 131, 181, 325
risk mitigation 177, 181
screening and testing 28, 32, 34, 64, 87, 94, 99, 100, 113, 114, 131, 137–138
secondary prevention 144, 150, 161, 325
tertiary prevention 144, 326
vaccination see vaccination
diseases see Annex II; bacterial diseases; captive/semit-captive settings, diseases/conditions in; parasites; viral infections; zoonoses; specific disease
distancing measures 60, 87, 91, 99, 103, 105, 176, 181
Djéké Triangle, Republic of Congo 222, 223
DNA (deoxyribonucleic acid) 17, 69–70, 102–103, 114, 135, 137, 319
documentation, disaster management 185–186, 296
domestic animals/livestock 34, 46–47, 62, 64, 65, 67, 68, 90, 92, 240
drowning 170, 285
dysbiosis 69–70, 319
dyspnea 278, 279, 281, 282, 319
Dzanga-Sangha, DRC 89–90, 221, 222, 289
eastern chimpanzee (Pan troglodytes schweinfurthii)
xiv–xv, xxi, xxiv–xxv, xxvii, xxviii, 24–25, 288; see also chimpanzees (Pan troglodytes)
eastern gorillas (Gorilla beringei); see also gorillas (Gorilla spp.); Grauer’s gorilla (Gorilla beringei graueri); mountain gorilla (Gorilla beringei beringei)
distribution xv
habitat types xxviii
home and day ranges xxx, xxxi
physiology xv–xvi
reproduction xxxi
social organization xvi
threats to xv
eastern hoolock (Hoolock leuconedys) xvii, xxii, xxvi–xxvii; see also Hoolock gibbons
Ebola virus disease (EVD) 12, 13, 14, 21–24, 126, 127, 137, 150, 151–152, 185, 192–193, 278
Echinococcus multilocularis (fox tapeworm) 33
Echinococcus granulosus 33
echocardiographers 71, 319
ecoimmunology 139–140
ecosystem health 44, 45, 46, 48, 55, 58, 61–65, 70, 72–73, 150, 319
ectoparasites 11, 29, 283, 319; see also sarcoptic mange (scabies)
ectopy 39, 320
electrocution 285
employee health programs 28, 62, 64–65, 131
encephalomyocarditis 126, 279, 320
Enclosure Design Tool (EDT) 52, 199, 246, 254, 255–257
enclosure designs 26, 30, 52, 94, 237, 240, 255–257
endoparasites 69, 320
Entamoeba spp. 32, 282
Enterobius spp. 32, 33, 283
epizootic neurologic and gastroenteric syndrome (ENGS) 278
Epstein–Barr virus 33
Equator Principles 215
ethics of ape care 142–144, 159–160
case studies 151–152, 153–155, 156–158
compassionate conservation 147–150
ethical importance of apes 211–212
“first, do no harm” approach 110, 140, 149, 152
general considerations 145–147
inclusivity 149
individual and collective importance 121, 145–147, 148–149, 159, 211–212
moral agency and moral courage 158–159, 159–160
peaceful coexistence 149–150
in sanctuary settings 156–158
secondary prevention 150, 153–156
tertiary prevention 156–158
vaccination 123, 126–127, 151–152
in wild settings 29, 116–117, 121, 153–155

F
facial dysplasia 30, 287, 320
feral animals 64, 180
field laboratories 28
fighting, inter- and intragroup 121, 286
filariaisis 282
“first, do no harm” approach 110, 140, 149, 152
fission–fusion dynamics 171, 205, 320
Five Domains Model 199, 235–236, 250
flooding 168–170, 192, 294–297
flukes (trematodes) 283
fomites 89, 100, 320
food security 56–58, 126, 320
forest fires
impacts on apes 28, 164, 165, 166, 171, 266, 284, 287
prevention and response strategies 73, 180, 183, 188–189, 190
Forest Stewardship Council (FSC) 216–218, 219, 223, 226
formulation, diet 36, 320
fungi 3, 6, 321

G
Gabon 21, 85, 96, 263, 264
Gaoligong hoolock (Hoolock tianxing) xvii, xxii, xxvi–xxvii; see also gibbons (Hylobatidae);
Hoolock gibbons
gastrointestinal diseases
bacterial 34, 69, 278, 280, 281, 282
parasitic 6, 7, 31–33, 64, 108–109, 282, 283
Primate Microbiome Project 69–70
viral 278, 279
gene sequencing 135–136, 137–138
sampling 102–103
geriatric disorders 4, 6, 37, 38–40, 277
Giardia spp. 32, 60, 125, 282
gibbons (Hylobatidae); see also specific genus;
specific species
abundance estimates xii
behavioral and ecological characteristics 205
CITES and IUCN listing xxii
cytomegalovirus 124
dental disease 40
dependency, alcohol/drug/tobacco 40, 284
diet xxix, 205
distribution xxii, xxvi–xxvii
emergency response plan 176, 178, 185, 190–191
forest fire impacts 167
gastrointestinal parasites 32–33
habitat types xxviii, 205
habituation 81, 90
health interventions 123–125
hepatitis A 279
hepatitis B 123, 124, 279
herpes viruses 33, 279
home and day range xxxi
illegal trafficking of 123–125
industrial impacts and mitigations 221, 299
locomotion 205
meliodosis 36
overview xvii
parasites 124–125
privately-held 123–125, 238
rehabilitation/release 238, 240
reproduction xxxii
species xxii–xxiii
territoriality 205, 240
vaccinations 103, 167
Gorilla Rehabilitation and Conservation Education Center (GRACE), DRC 199, 257–258
gorillas (Gorilla spp.); see also specific species; specific subspecies
age-related diseases 37
anthrax 19
in captive situations 257–258, 262–263, 265, 266, 267, 268, 269, 270, 279, 310
cardiovascular disease 37, 38, 71
COVID-19 60, 87, 174, 176, 181, 185, 186, 278
dental disease 40
diet xv, xxviii–xxix, 205
distribution xv
Girardia diseases 60
habitat types 205
health interventions 117, 118, 119, 121, 133, 135, 151–152; see also Gorilla Doctors
hepatitis B 279
herpes viruses 33, 94, 279
home and day ranges xxx
human conflict with 68, 89
human metapneumovirus (HMPV) 25, 289
human orthopneumoviruses 289
human respiratory syncytial virus (HRSV) 25
intestinal impacts and mitigations 209, 223–224, 226, 299
inter- and intragroup fighting 121
life expectancy xv–xvi
leprosy 12
locomotion 205
malaria 12
measles 117
meliodosis 36
monkeypox virus (MPXV) 36
necropsy numbers xv
obesity 37
overview xv–xvi
parasites 133, 135
as pets 96
physiology xv–xvi
reproduction xxi–xxii, xxxiii
reproductive diseases 25, 90, 289
severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) 35–36, 60, 181
simian immunodeficiency viruses (SIVs) 24
snare injuries 121
social organization xv, xx, xxii–xxiv, 22, 205
socioecology xx–xxxiii
threats to xv
vaccinations 126, 151–152
yaws (TPE) 12, 17–18
Goualougo Triangle Ape Project 221–224
Grauer’s gorilla (Gorilla beringei graueri) xv, xxi, xxiv–xxv, 62–65, 94, 115; see also eastern gorillas (Gorilla beringei); gorillas (Gorilla spp.)
Greater Virunga Transboundary Collaboration 176, 178, 185, 186–187, 188
Guinea 17, 68, 192–193, 199, 210, 214, 227–230, 263, 264, 298
Guinea-Bissau 18
Gunung Palung National Park, Indonesia 67–68, 74, 75, 165
gut microbiome 6–7, 31, 32, 41, 69–70, 124
habitat loss/fragmentation/degradation; see also agriculture; deforestation; industrial development projects; logging; mining; resource extraction; roads and disease ecology 101, 102
due to tourism 88
and genetic degradation 120
and health risks 4, 28, 30, 52, 58, 66–67, 92, 101, 102
leading to human–ape conflict 14, 58
leading to human–wildlife interactions 3, 4, 52, 58
and vulnerability to natural hazards 162–164
habituation
benefits versus costs 83, 84
best management practices (BMPs) 81
captive apes
behavioral impacts 83
disease transmission risks 78, 79, 92–95
habitation process 82–83
human reasons for 82–83
reversing habitation 83
defining 81, 321
as disease risk factor 12, 62, 78, 79, 81, 88, 89, 90, 91, 92–95
evidence-based risk assessments 100–101, 106
limitations and financial costs 87–90
minimizing risks 79–80, 81
overhabituation 78, 88–89
reversing 83
wild apes
behavioral impacts 78, 79, 81, 87, 88
benefits to apes 83–84
best management practices (BMPs) 81
disease transmission risks 78, 79, 81, 88, 89, 91
due to tourism and research 76–77, 78
financial costs 89–90
habitation process 80–81
human reasons for 79, 80–81
increase in 89
length of process 81
negative consequences 78, 81, 87–88, 88–89
overhabituation 88–89
Hainan gibbon (Nomascus hainanus) xiii, xxii, xxvi–xxvii, 176, 178, 185, 190–191, 299; see also gibbons (Hylobatidae); Nomascus gibbons
health interventions see interventions, ape health
helminths 31, 32–33, 133, 135, 283, 321
hepadnavirus 114, 321
hepatitis A 94, 279
hepatitis B 94, 114, 123, 124, 126, 279
herpes viruses 33, 94, 279
histopathology 135, 321
HIV-1 12, 13, 24
Hoolock gibbons; see also gibbons (Hylobatidae);
specific species
CITES and IUCN listing xxii, xxiii, xxvi–xxvii, xviii, xxii–xxiii, xxvi–xxvii
distribution xviii, xxii–xxiii, xxvi–xxvii
numbers xviii
offset legislation 214
physiology xviii–xviii
social organization xviii
species xxii
human coronavirus OC43 25, 26, 279, 288
human coronaviruses (HCoV) 13
human immunodeficiency virus (HIV) 12, 13, 24, 64
human metapneumovirus (HMPV) 13, 25, 26, 27, 35, 288, 289
human orthopneumoviruses 25, 279, 288, 289
human respiratory syncytial virus (HRSV) 13, 25–26, 26–27, 35
human respiratory virus 3 25, 279, 288
human rhinovirus C ("common cold") 13, 25, 278, 288
human rhinovirus C 13, 25, 278, 288
hunting/poaching see poaching/hunting
hydropower 205, 206, 230, 298–300; see also industrial development projects
hygiene 26, 28, 36, 60, 86, 144
Hylobates gibbons; see also gibbons (Hylobatidae);
specific species
CITES and IUCN listing xxii–xxiii
distribution xviii, xxii–xxiii, xxvi–xxvii
home and day range xxxi
numbers xviii
offset legislation 214
overview xviii
physiology xviii
social organization xviii
species xxii
hyperendemic regions 19, 20, 321
hypertension 38, 39, 71, 321
hypertrophy 38, 321
hypoplasia 39–40, 277, 321
hypotension 122, 321
hypothermia 122, 322
idiopathic myocardial fibrosis 71, 285, 322
imidacloprid 30, 287, 322
immunocompetence 90, 322
immunofluorescence antibody assays 32
India 84, 265, 266, 299
Indigenous Peoples and Local Communities (IPLCs) see communities, local
Indonesia; see also Borneo; Sumatra
agribusiness 299
animal welfare 247, 265
deforestation 112, 113
disaster management 180
forest fires 167, 180, 189
infrastructure development 299
interventions, ape health 112–114
lawsuit regarding captive wildlife 241
meliodosis 36
rescue/rehabilitation centers 112–114, 240, 246, 266–267
tourism 84
translocations 128–129
tuberculosis (TB) 34, 138
industrial development projects 230; see also agriculture; infrastructure development; mining; roads
biodiversity impacts 202
case studies 221–224, 225–226, 227–230
critical threat to apes 200–201
expected prevalence 2020–2025 and risks to apes 298–300
future needs
conservationists–industrialists
communication 224
defining ape priority areas 224
government engagement 224, 225–226
policy improvements 224–225, 227–230
standardizing mitigation metrics 225
impacts on apes 206–208
industries in ape ranges 205–206
legislation and regulations 202
long-term research and monitoring 221–224
managing cumulative impacts 220–221
mitigation approaches 208–219, 228, 230
mitigation factors to consider 202–206
mitigation guidelines 219–220
mitigation hierarchy 301–302
mitigation issues linked to ownership change 224–225, 227–230
strategic environmental assessments (SEAs) 220–221
infanticide xxxii–xxxiii, 322
influenza (flu) 35, 50, 230, 280, 322
infrastructure development 28, 66, 88, 164, 228, 298–300; see also industrial development projects; roads
interbirth intervals xxxii, 322
interferon-gamma assays 137–138, 322
international conventions and declarations 241–244; see also Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES); International Union for Conservation of Nature (IUCN)
International Primate Heart Project (IPHP) 39, 71
International Union for Conservation of Nature (IUCN) Avoid, Reduce, Restore and Conserve (ARRC) Task Force 199, 204, 218–219, 224
capacity building programs 65–66
COVID-19 guidelines 130, 171, 176, 181
IUCN–CITES task force 243
A.P.E.S. Database 1, 219
Primate Specialist Group (PSG) 97, 98, 176, 215, 218, 248, 250
Red List xiv, xv, xvii, xviii, xix, xx, xxii–xxiii, 97, 274–275
Species Survival Commission, Primate Specialist Group 218
interventions, ape health 108–140
anesthesia use 29, 115, 116, 117–118, 120, 122, 128, 139, 155, 156–158
behavioral studies, landmark 115–116
best practice guidelines 112, 128
capacity building 128–129, 130–132
captive settings 112–114
case studies 120, 121, 123–125, 130, 131–132, 137–138
collection (see also “collecting”)
collection research 38, 39, 71, 125, 277, 280, 322
collection (see also “collecting”)
collection research 38, 39, 71, 125, 277, 280, 322
collection research 32
conservation biology 193, 248–250
conservation physiology toolbox 136, 139
decision-making process 110, 112, 118–121, 140
diagnostics, improving 135–136, 137
duty-of-care concept 112
ecoimmunology 139–140
ethical considerations see ethics of ape care history and evolution of
112–118
human-caused injuries 117, 121, 150, 153–156
radio telemetry 139
rescuing apes from illegal captive situations 118
risks for humans and apes 117
tools 127–140
translocations see translocations
vaccinations see vaccination
intrinsic value 147, 211, 241, 322
Ivory Coast 16, 17, 18, 19, 21, 25, 90, 262, 263, 264, 288
K
Kahuzi-Biega National Park, DRC xv
Kalimantan, Indonesian Borneo 67–68, 72–73, 87, 88, 113, 165, 167, 180
Klebsiella pneumoniae 280, 289
Kloss’s gibbon (Hylobates klossii) xxii, xxvi–xxvii; see also gibbons (Hylobatidae); Hylobates gibbons
Koukoutamba dam, Guinea 298
L
Lao People’s Democratic Republic (Lao PDR) 84, 210, 266
lar gibbon (Hylobates lar) xviii, xxii, xxvi–xxvii, 32–33; see also gibbons (Hylobatidae); Hylobates gibbons
legislation and regulations
on animal welfare 234, 240–241, 305–306
API scores 261–262, 263–265, 267
on industrial development 226, 228, 230
positive developments in 202, 226, 303–304
on protection of apes 210, 214
on strategic environmental assessments (SEAs) 220–221, 226, 228, 230
on tourism and research 98, 100
leprosy 12, 18, 280
lesions 16, 17, 18, 38, 39, 71, 125, 277, 280, 322
Liberia 19, 192–193, 263–264
live ape trade see trafficking, wild animal
liver disease 38, 69, 114, 277, 279; see also hepatitis B
livestock see domestic animals/livestock
locomotion
arbreoral 89, 205, 209, 255, 257, 317
terrestrial 205, 208, 326
logging 62, 66, 67–68, 133, 164, 206, 221–224, 225–226, 298–300; see also deforestation; habitat loss/fragmentation/degradation; resource extraction
lymphocryptovirus 33

M
macroparasites 6, 322
malabsorption 94, 96
malaria 12, 30–31, 114, 283
Malaysia 34, 36, 84, 114, 247, 265, 266; see also Borneo
malnutrition 36–38, 56, 94, 96, 124, 166, 286
management systems, disaster 187–190
mange mites/scabies 16–17, 59, 60, 89, 94, 283
measles 13, 64, 89, 94, 99, 117, 126, 151–152
melioidosis (a.k.a. Whitemore’s disease) 36, 280
meningitis 94
metabarcoding 29, 33, 322
metabolic bone disease 37, 40
metabolic syndrome 39, 322; see also helminths
Mgahinga Gorilla National Park, Uganda 85, 87
minimization step of mitigation strategy 209–210, 212, 302
mining 28, 30, 66, 67, 206, 210, 218, 224, 227–230, 287, 298–300, 301–302; see also infrastructure development; resource extraction
moloch gibbon (Hylobates moloch) xviii, xxii, xxvi–xxvii; see also gibbons (Hylobatidae);
Hylobates gibbons
Mondika field station, Central African Republic 221–224
monkeypox virus (MPXV) 6, 10–11, 13, 15–16, 36, 280
moral agency 147, 158–159
moral courage 145, 158–159, 159–160, 322
moral distress 159, 160, 322
moral resilience 145, 159–160, 322
moral standing/status 144, 146, 323
mosquitoes 30, 31, 170, 283
Mountain Gorilla Veterinary Project/Gorilla Doctors see Gorilla Doctors
mountain gorilla (Gorilla beringei beringei); see also
eastern gorillas (Gorilla beringei); gorillas (Gorilla spp.)
behavioral studies, landmark 115
cardiovascular disease 37
CITES and IUCN listing xxii
COVID-19 87, 176, 178, 181, 186
diet xvi, xxiii
distribution xxi, xxiv–xxv
gastrointestinal parasites 33
habituation 81, 88, 89, 90, 98
health interventions 114–115, 119, 121, 133, 135
home and day range xxxi
human metapneumovirus (HMPV) 25, 289
human orthopneumovirus A 289
humans, conflict with 89
humans, interaction with 60, 98
lymphocryptovirus 33
numbers xv
parasites 88, 90, 133, 135
population growth 60, 86
renal disease 39
reproduction xxxiii
respiratory diseases 90, 151–152
sarcoptic mange (scabies) 16, 59
social organization xxii–xxiii, xxiv
tourism 83, 84–85, 85–86, 87, 95, 98, 116
vaccinations 126, 151–152
Moyen-Bafing National Park, Guinea 210
Müller’s gibbon (Hylobates muelleri) xviii, xxii, xxvi–xxvii; see also gibbons (Hylobatidae);
Hylobates gibbons
Myanmar 68, 265, 299
Mycobacterium leprae 18, 280
Mycobacterium lepromatosis 18

N
nasal flora 26, 323
natural parks see specific park
natural disasters see disaster impacts; disaster management
necropsies 17, 18, 28, 29, 323; see also post-mortem examinations
necrotizing dermatitis 17, 323
necrotizing inflammation 32, 323
nematodes 32–33, 135, 282, 283, 323
nephritis 39, 277, 323
nesting xxxi
neurological diseases/conditions 30, 278, 287
next-generation sequencing (NGS) 6, 135, 323
Ngamba Island Chimpanzee Sanctuary, Uganda 104–105, 168–170, 294–297
Niger 262
Nigeria 262, 263, 264
Nigeria–Cameroon chimpanzee (Pan troglodytes ellioti) xv, xxi, xxiv–xxv, 209; see also chimpanzees (Pan troglodytes)
Nigerian Cross River superhighway 209
Niokolo-Koba National Park, Senegal 301–302
nodules 18, 280, 323
Nomascus gibbons; see also gibbons (Hylobatidae); specific species
CITES and IUCN listing xxiii
distribution xviii, xxiii, xxvi–xxvii
home and day range xxxi
numbers xviii
offset legislation 214
overview xviii–xix
parasites 32
physiology xix
social organization xix
species xxiii
northeast Bornean orangutan (Pongo pygmaeus morio) xxi; see also Bornean orangutans (Pongo pygmaeus)
northern white-cheeked crested gibbon (Nomascus leucogenys) xxiii, xxvi–xxvii, 32; see also gibbons (Hylobatidae); Nomascus gibbons
northern yellow-cheeked crested gibbon (Nomascus annamensis) xxiii, xxvi–xxvii, 210; see also gibbons (Hylobatidae); Nomascus gibbons
northwest Bornean orangutan (Pongo pygmaeus pygmaeus) xxi; see also Bornean orangutans (Pongo pygmaeus)
Nouabalé-Ndoki National Park (NNNP), Republic of Congo 221–224
nucleic acids 29, 135, 323; see also DNA (deoxyribonucleic acid); RNA (ribonucleic acid)
nutrition 56–58; see also malnutrition

O
obesity 36, 37, 69, 286
ocular conditions 38, 277
Odzala-Kokoua National Park, Republic of Congo 22–23
Oesophagostomum spp. 32, 283
offsetting step of mitigation hierarchy 210, 212–213, 302
One Health strategy
aims 50
and animal welfare 236
Berlin Principles 48
community health initiatives 53, 55–56, 137
defining 44, 49, 50, 323
globalization of principles 49–51
health interventions 150, 151, 154
history and evolution of 43–44, 46–47
human behaviors and spillover risks 52–53
and the Human–Ape Interface 51–58
improving human health to improve wildlife health 53, 55–56, 59–60, 86
integrated risk management 159–160, 174
intersections and convergences of related disciplines 48–49, 49–50, 75, 236
and land use changes 66–68
Manhattan Principles 46
translational medicine 70, 71
translocation applications 133, 134
One Welfare framework 52, 236, 305, 309, 323
operant conditioning 29, 157, 245, 323
orangutans (Pongo spp.); see also specific species; specific subspecies
age-related diseases 37
air sacculitis 35, 281
arboreal nature of xxx–xxxi
behavioral and ecological characteristics 205
behavioral studies, landmark 116
cardiovascular disease 38
CITES and IUCN listing xvi, xxi
definition of 120
dentition 40
diagnostics 138
diet xvi, xxviii, xxix, 205
Dirofilaria immitis 282
disease transmission from humans 94, 95, 114
distribution xvi, xx, xxi, xxvi–xxvii
Ebola virus 21–22, 24
flanged/unflanged 320
forest fire impacts 28, 164, 167
gastrointestinal illnesses 32, 33, 69
gut microbiome 69–70
habitat loss/fragmentation/degradation 167
habitat types xxviii, 205
habitation 81
health interventions 112–114
hepatitis B 279
herpes viruses 33, 279
home and day range xxx–xxxi
illegal captivity 241
industrial impacts 299
interbirth interval xvii, xxxii
life expectancy xvi
locomotion 205
malaria 30–31, 114
meliodosis 36
monkeypox virus (MPXV) 36
nesting xxiii
numbers xvi
numbers in captive settings 262, 265, 266–267, 268, 269
obesity 37
overview xvi–xvii
physiology xvi
Pseudomonas spp. infections 281
release programs 246, 250, 253, 254
renal disease 39
reproduction xxxii, xxxiii
respiratory diseases 27, 28, 34, 35
smoke inhalation 28, 164
social organization xvii, xx, xxiv–xxv, 205
socioecology xx–xxxiii
solitary lifestyle 12
species xxi
stress impacts 83, 87, 88, 92
threats to xvi
ticks 102
tourism 84, 85, 88, 92
tuberculosis (TB) 34, 114
vaccinations 126
vocalizations 103
weaning ages xxxii
worms 114
Orthopoxvirus see monkeypox virus (MPXV)
osteoarthritis 37, 38, 39, 277, 324
osteopenia 37

Paramyxoviridae 25, 279, 288
parasitemia 30–31, 324
parasites
defining 324
filaria 282
gastrointestinal 7, 31–33, 64, 69, 90, 108–109, 282
health interventions 133, 135
helminths 31, 32–33, 114, 124–125, 133, 135, 283, 321, 326
host–parasite ecoevolutionary dynamics 140, 276
in illegally-trafficked apes 124–125
mange mites/scabies 16–17, 59, 60, 89, 94, 283
Plasmodium spp. 12, 13, 30–31, 114, 283, 324
protozoa 6, 31, 32, 282, 283, 324
Pasteurella multocida 27–28, 281
pathogenicity 102, 135, 324
PEESTOLM risk management approach 164, 172, 174, 290–292
personal protective equipment (PPE) 6, 26, 27, 100, 171, 176
personhood 146, 236, 324
pesticides 30, 287
pets, apes as 33, 94, 96, 118, 267
pets, non-ape see domestic animals/livestock
phages 41, 324
Pic de Fon Classified Forest, Guinea 227–230
Picornaviridae 278, 288
piledated gibbon (Hylobates pileatus) xviii, xxiii,
xxvi–xxvii, see also gibbons (Hylobatidae);
Hylobates gibbons
planetary health paradigm 45, 48, 58, 110, 324;
see also One Health strategy
Plasmodium spp. 12, 13, 30–31, 114, 283, 324
pneumococcus (Streptococcus pneumoniae) 26–27, 35, 126, 281–282, 288
pneumoviruses (Pneumoviridae) 25, 26, 27, 35, 279, 288, 289, 324
poaching/hunting; see also snares/traps; wild meat
consumption/trade and ape numbers in sanctuaries 262, 263, 264
COVID-19 impacts 60, 87, 99, 174
deforestation impacts 88, 164
disease transmission 4, 14, 24, 100, 137
roads, impact of 28, 206, 208
sustainable hunting 58
and tourism 85, 86
poisoning 30, 166, 287
polio 117, 151
poliomyelitis 281
pollution 30, 67, 88, 100, 167, 287
polymerase chain reaction (PCR) tests 135–136, 137, 138, 324
positive reinforcement training 83, 157, 258, 324
post-mortem examinations 29, 30, 64, 115, 131, 324
see also necropsies
post-traumatic stress disorder (PTSD) 40, 158, 159, 284
preDiabetes 37, 324
preparedness, disaster; see also risk assessments
capacity and capability 184–185, 296
case study 168–170, 294–297
documentation 185–186, 296
evacuation plans 190
exercises and drills 190, 297
governance structures 186–187
health interventions 117–118
management systems 187–190, 297
monitoring/reviewing 193, 194–195
non-human resources 185, 191
overview 181–184
reputational risk assessment 293
primary prevention 144, 150, 324
Primate Microbiome Project 69–70
Project ChimpCARE Chimpanzee Assessment 311–312
pro-poor tourism 85–86, 324
proteomics 136, 324
protozoa 6, 31, 32, 282, 283, 324
Pseudomonas spp. 281
psychological disorders 40, 284
quarantine 26, 28, 34, 87, 91, 99, 131, 181, 325
radio telemetry 139, 253, 325
railways 227, 287
recovery from disasters 168–170, 171–172, 179, 183, 191–192
regulations see legislation and regulations
rehabilitation/restoration step of mitigation 210, 302
renal disease 30, 37, 38, 39, 277, 287
Republic of Congo 17, 21, 22–23, 137, 221–224, 263, 264
reservoirs, disease 15, 17, 21, 24, 31, 36, 52, 126, 325
resource extraction 60, 66, 67, 68, 75, 223; see also industrial development projects; logging; mining
respiratory diseases 15, 25–28, 34–36, 41, 90, 94, 95–96, 102, 116, 151–152, 167; see also specific disease
responses, disaster 168–170, 184, 186, 190–191, 193, 194–195
retroviruses 24–25, 281, 325
rickets 37
risk assessments; see also disaster management
compounding risks 174–177, 318
of Congo Basin forestry 221–224
in contingency plans 186
guidance 174
for habituation 101, 103
for health interventions 29, 110, 112, 119, 126, 127, 131–132, 149, 152, 153–154, 156, 158
of Ngamba Island flooding 168–170, 294–295
PEESTOLM approach 164, 172, 174, 290–292
for reintroductions/relocations 36, 120, 133, 134, 190–191, 212
reputational risk assessment 293
reviewing 193
risk mapping 180, 195
as start of preparedness 181, 185
risk management 119, 133, 170, 172–178, 195, 215
risk mapping 165, 180, 294
RNA (ribonucleic acid) 27, 135, 325
roads 3, 28, 30, 200–201, 202, 206, 208, 209, 222, 223, 228, 287, 298–299; see also infrastructure development
Roundtable on Sustainable Palm Oil (RSPO) 216
roundworms (nematodes) 32–33, 135, 382, 283, 323
Rungan River Landscape, Borneo 72–73
Rwanda
COVID-19 impacts 174–177, 181
Ebola virus disease (EVD) 185
Gorilla Doctors 62, 63, 64, 114–115
habitat loss/fragmentation/degradation 101
habitation, rise in 89
interventions, ape health 114–115, 117
respiratory diseases 25, 289
tourism 84–85, 85–86, 174–177, 192
Sabah, Malaysian Borneo 70, 85, 87, 88, 94, 95
Salmonella spp. 32, 281, 282
sampling/testing 20, 29, 64, 91, 102–103, 117, 135–136, 137–138, 140
sanctuaries; see also captive ape welfare; captive/semi-captive settings
accreditation 244
animal welfare 238, 244, 245, 246, 248, 255–257
ape numbers/status in Africa 262–264
ape numbers/status in Asia 266–267
ape numbers/status in Europe 267
ape numbers/status in the USA 270
collaboration 257–259
disaster management 168–170, 294–297
disease transmission risk to/from humans 80
diseases/conditions in 21, 36, 38
Enclosure Design Tool 255–257
health care provision 156–158
operating at or over capacity 270
reputational risk assessment 293
Sangha Trinational (TNS) region, Congo Basin 221–224
Sarcoptes scabiei 16–17, 59, 60, 89, 94, 283, 317
sarcoptic mange (scabies) 16–17, 59, 60, 89, 94, 283, 317
screening 32, 62, 64, 82, 94, 100, 113, 114, 131, 137–138
scurvy 37
Sebangau National Park, Borneo 72, 73, 167
secondary prevention 144, 150, 161, 325
semi-terrestriality xxx
Senegal 164, 301–302
sentience 211, 212, 233, 234, 236, 237, 259, 261, 325
septicemia 124, 277, 280, 325
seroconversion 114, 124, 325
serology 29, 114, 325
severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) xi, 7, 13, 35–36, 45, 60, 66, 171, 174, 176, 181, 278; see also COVID-19
shared situational awareness 187, 196, 325
siamang (Symphalangus syndactylus) xix, xxiii, xxvi–xxvii, xxix, 214, 310; see also gibbons (Hylobatidae)
Sibual-Buali Nature Reserve, Sumatra 97, 103, 187–188, 267–268
Sierra Leone 192–193, 261, 264, 278
Simandou Mine, Guinea 227–230
simian acquired immunodeficiency syndrome (SAIDS) 24, 281
simian immunodeficiency viruses (SIVs) 13, 24–25, 281
smallpox 15
smoke inhalation 28, 164, 167, 287
snares/traps 6, 87, 115, 116, 117, 121, 153–156, 174, 286
social media 97, 103, 105, 187–188, 267, 270
sociality/social organization 11–12, 15, 21, 22–23, 25, 90, 205, 211, 325
socioecology, of apes xx–xxxiii
southern white-cheeked crested gibbon (*Nomascus siki*) xvi, xiii, xxvi–xxvii, 210; see also gibbons (Hylobatidae); *Nomascus* gibbons
southern yellow-cheeked crested gibbon (*Nomascus gabriellae*) xvi, xiii, xxvi–xxvii, 210; see also gibbons (Hylobatidae); *Nomascus* gibbons
southwest Bornean orangutan (*Pongo pygmaeus wurmbii*) xxi; see also Bornean orangutans (*Pongo pygmaeus*)
spillback 45, 137, 325
spillover events
  bi-directionality 7, 13, 14, 15
  in captive situations 4, 6
  defining 12, 325
  examples 13, 18, 21, 26, 91, 137
  risk factors 45, 53, 55, 79, 80, 92, 113, 134, 230
  risk management 95, 97, 106–107, 137, 151
  transmission settings 14
standard operating procedures (SOPs) 87, 94, 95, 97, 98, 245, 246, 326
strategic environmental assessments (SEAs) 220–221, 230
*Streptococcus pneumoniae* (pneumococcus) 26–27, 35, 126, 281–282, 288
stress
to apes
  impact on gut microbiome 70
  impact on mental health 30, 40, 158, 284
  impact on physical health 6, 30, 83, 87–88, 90, 106, 124
  physiology metrics 136
  in rehabilitation/release programs 212, 239
to humans working with apes 159–160
*Strongyloides* 32–33, 114, 124–125, 135, 283, 326
Sumatran orangutan (*Pongo abelii*); see also orangutans (*Pongo* spp.)
CITES and IUCN listing xxi
diet xvi, xxi
distribution xvi, xxi, xxvi–xxvii
habitat types xxviii
inbreeding concerns xvi
industrial impacts and mitigations 230, 299
numbers xvi
resilience xxix
threats to xvi
translocation risk matrix 134
tapeworms (cestodes) 32, 33, 283
terrestrial locomotion 205, 208, 326
“territories of life” 68
tertiary prevention 144, 326
testing see sampling/testing; screening
ticks 102
tourism and research 59–60, 62–64, 77–107, 248–250; see also habitation
  aiding conservation 60, 83–84, 86–87, 105–106
  and animal welfare 248, 250, 303
  benefits/costs to local communities 78, 85–86
  best management practices (BMPs) 91, 97–100, 105
  COVID-19 impacts 85, 97, 174–176, 181, 264, 270
  disease prevention strategies 28, 91, 97–103, 106–107, 176, 181
  as disease risk factor 78, 89, 90, 91, 94, 95–97, 116
  evidence-based assessments 100–101
  GDP from 78, 84–85
  human fascination with apes 78
  impact on health interventions 121
  improving for ape health 103–107
  key findings on impacts of 80
  negative impacts on apes 40, 78, 81, 87, 88, 284
  photographs 97
  post-COVID recovery 192
  trafficking, wild animal 123–125, 238, 259, 263, 264–265, 266, 267, 268, 270, 303
translational medicine 50–51, 70, 71, 326
translocations
  anesthesia use 120, 122
COVID-19 impacts 171
decision-making 120
and disease risk 69, 94–95, 118, 120
and human–ape conflict 118, 120
Indonesia’s plan for 129
IUCN guidelines 128–129
as part of disaster management 182, 189, 190–191
rights approach to 212
risk management 36, 133, 134, 139
stress 40, 284
traps/snakes see snakes/traps
trematodes 32, 283
Treponema pallidum pertenue (TPE) 17–18, 282
Trichuris spp. 32, 125, 283
typhoid fever 94, 282
U
Uganda
ape diseases/conditions found in 16, 25, 30, 59, 287, 288
community engagement 59–60, 68, 85–86
COVID-19 impacts 87, 174–177, 178, 181
COVID-19 safe practices 60, 176, 181
disaster management 168–170, 181, 294–297
Greater Virunga Transboundary Collaboration 176, 178, 185, 186–187, 188
habitat loss/fragmentation/degradation 3
health interventions 108–109, 153–156
human–ape conflict 89
Ngamba Island Chimpanzee Sanctuary 168–170, 294–297
numbers of apes in sanctuaries 263, 264
pesticide poisoning 287
strategic environmental assessments (SEAs) 220
ultrasound 29, 71, 115, 326
United Arab Emirates (UAE) 118, 123–125, 265, 267
Universal Declaration on Animal Welfare (UDAW) 243–244
utilitarianism 146, 326
V
vaccination
of dogs/cats 65
ethical complexities 123, 126–127, 151–152
of humans 26, 27, 28, 55–56, 64, 176
of non-ape wildlife 126
varicella-zoster virus 33
vectors, disease 65, 326; see also reservoirs, disease
Versteia mustelae 33
vicarious resilience 160, 326
vicarious traumatization 159–160, 326
Vietnam 210, 265, 266
Virunga Massif, Rwanda and DRC xxviii, 60, 87, 89, 98, 115, 188
Virunga National Park 63, 64, 77–78, 85, 135, 174, 198
viruses see specific virus
vitamins 37
Volcanoes National Park, Rwanda 64, 85, 101, 289
W
weaning ages xxxii
welfare see captive ape welfare
western black crested gibbon (Nomascus concolor) xviii, xxxii, xxvi–xxvii; see also gibbons (Hylobatidae); Nomascus gibbons
western chimpanzee (Pan troglodytes versus); see also chimpanzees (Pan troglodytes)
CITES and IUCN listing xx
limits disease transmission from humans 25, 26, 288
distribution xxi, xxiv–xxv
habitat type xxvii
human metapneumovirus (HMPV) 25, 26
human respiratory syncytial virus (HRSV) 25
increased sanctuary intake of 264
industrial impacts and mitigations 210, 227, 298, 301–302
leprosy 18
numbers xiv
population declines xv
western gorillas (Gorilla gorilla); see also Cross River gorilla (Gorilla gorilla diehli); gorillas (Gorilla spp.); western lowland gorilla (Gorilla gorilla gorilla)
diet xxix
distribution xv
habitat types xxviii
home and day range xxx, xxxi
physiology xv–xvi
reproduction xxxii, xxxiii
social organization xvi, xxiii
threats to xv
western hoolock (Hoolock hoolock) xvii, xxii, xxvi–xxvii; see also gibbons (Hylobatidae); Hoolock gibbons
western lowland gorilla (Gorilla gorilla gorilla); see also gorillas (Gorilla spp.); western gorillas (Gorilla gorilla)
cardiovascular disease 38
CITES and IUCN listing xxi
Congo Basin studies 222
distribution xxiv–xxv
Ebola virus 22–23
gastrointestinal parasites 32
habituation 81, 89–90, 92
home and day range xxxi
human orthopneumovirus A 289
human respiratory syncytial virus (HRSV) 25
individual’s importance 145
industrial impacts 299
population estimate xv
simian immunodeficiency virus (SIVgor) 24
sociality/social organization 22–23
wild meat consumption/trade 14, 56, 60, 137, 262, 263
Wildlife Wood Project (WWP), Cameroon 199, 224, 225–226
World Health Organization (WHO) 2, 18, 48, 50, 87, 171, 174, 187, 190, 193, 194
World Organisation for Animal Health (OIE) 48, 50, 66, 243
worms 32–33, 114, 124, 133, 135, 283

Y
yaws (TPE) 12, 17–18, 89, 282
yeast infections 125

Z
Zaire ebolavirus (ZEBOV) 21, 278
zoonoses; see also specific disease
defining 4, 327
disease transmission
apes-to-humans 21, 24, 89, 127, 137
domestic animals/livestock-to-apes 90, 92
humans-to-apes 12, 15, 16–17, 26–27, 32, 33, 34, 35–36, 64, 78–79, 89, 90, 91, 94, 288–289
other wildlife-to-apes 34, 278
other wildlife-to-humans 34, 36
One Health strategy see One Health strategy
PEESTOLM Risk Register 172, 174, 290–292
spillback 45, 137, 325
spillover events see spillover events
zoos; see also captive ape welfare; captive/semi-captive settings
accreditation 244
animal transfer between 238
and animal welfare 237, 244, 247–248, 251–252, 310, 311–312
ape numbers/status in Africa 262
ape numbers/status in Asia 265–266
ape numbers/status in Europe 267, 268
ape numbers/status in Latin America 268
ape numbers/status in Oceania 269–270