Chapter 18
The Aggressive Apes? Causes and Contexts of Great Ape Attacks on Local Persons

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Attacks and Human-Directed Aggression by Wild Animals

One of the main challenges to biodiversity conservation globally is the rising level of interaction between humans and wild animals, and the resulting conflicts that can emerge (Conover 2002; Hill et al. 2002; Woodroffe et al. 2005). Living alongside wildlife can impose substantial costs upon local people that are frequently cited as the drivers of human–wildlife 'conflict' (see section 'Understanding Great Ape Attacks in the Context of Human–Wildlife "Conflict"' for discussion of conflict definitions), including financial and social costs associated with crop losses and livestock depredation, and risks to human health and well-being from wildlife (Hill 2004; Thirgood et al. 2005; Wang and Macdonald 2006; Mackenzie and Ahabyona 2012; Barua et al. 2013). Human-directed aggression by wild animals— and physical attacks by large mammals in particular—are an especially serious cause of negative human–wildlife interactions. We define an attack as an aggressive interaction involving physical contact, potentially leading to human injury or loss of life. While usually rare, a single attack by a wild animal can elicit more hostility and panic than less immediately severe, but persistent problems associated with human–wildlife sympatry, such as wildlife feeding on agricultural crops (commonly referred

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to as 'crop raiding') or livestock depredation (Hockings et al. 2010). Wildlife attacks—including fear of attack (Kaltenborn et al. 2006)—directly impact the willingness of local communities to tolerate wild animals in their environment, thus reducing their support for conservation (Hill et al. 2002). Even so, and despite their intrinsic negative impact on human well-being, detailed and systematic records of animal attacks are rare, and little is often known about the circumstances surrounding cases (Quigley and Herrero 2005; Thirgood et al. 2005). It is therefore imperative to seek a better understanding of the frequency, causes and circumstances of human-directed aggression by different wildlife groups and species, in order to inform appropriate mitigation strategies and facilitate human–wildlife coexistence. Here, our focus is on large mammal attacks only.

Large mammals attack hundreds of people globally each year, with attacks by big cats (e.g. tigers, *Panthera tigris*), bears (e.g. sloth bear *Melursus ursinus*) and large herbivores such as elephants (*Elephas maximus* and *Loxodonta africana*) receiving most attention (Rajpurohit and Krausman 2000; Löe and Röskaft 2004; Packer et al. 2005; Dunham et al. 2010). Attacks by wild large mammals are particularly problematic because they tend to elicit strong, often 'negative', responses (Quigley and Herrero 2005) and are difficult to prevent entirely where humans and wild animals share an environment (Kushnir et al. 2010; Dhanwatey et al. 2013). Attacks occur for diverse reasons and classifying them is often not straightforward. Quigley and Herrero (2005) used the broad categories of 'provoked' and 'unprovoked' to characterise attacks by terrestrial large carnivores. Although the circumstances surrounding provoked attacks vary, they occur most commonly when a person enters an animal's 'personal space' (i.e. the area around an animal in which it reacts to human presence, which depends on the specific conditions of the situation; Quigley and Herrero 2005). Entering an animal's personal space need not imply intentionality or aggression by the person(s). For example, attacks by sloth bears in India commonly occurred when the bears encountered unsuspecting humans who were engaged in activities such as defecation outdoors (Bargali et al. 2005). In other situations, however, an animal attacks when a person(s) enters its personal space and purposefully attempts to approach, touch, capture, injure or kill it. For example, Neto et al. (2011) report a nonfatal attack on a man by a jaguar (*Panthera onca*), which reportedly occurred after his dogs cornered the cat; the man was attacked when he approached to help his dogs fight the jaguar. Regardless of whether purposive human aggression is involved, most provoked attacks are ultimately defensive with the animal responding to a perceived human threat (Quigley and Herrero 2005).

Provoked attacks also occur when a person(s) has food or garbage attractants that draw an animal near the person to within its personal space, as characterises some attacks by brown bears (*Ursus arctos*) (Herrero and Higgins 2003). Feeding wild animals, or using food to lure an animal closer, are commonly cited factors in wildlife attacks on tourists (Orams 2002). More generally, attacks by large mammals become increasingly likely where natural habitats are degraded through human activities that reduce or alter the food choices available, potentially causing animals to range nearer to human settlements (Bargali et al. 2005).

Unprovoked attacks occur when the animal approaches and attacks a person(s) who is the principle attractant, for example, predation on humans by large carnivores (Quigley and Herrero 2005). While predatory attacks are opportunistic in many cases, big cats can become dedicated 'man-eaters' in some situations, repeatedly targeting humans as prey (e.g. lions *Panthero leo*, Kerbis-Peterhans and Gnoske 2001; tigers, Gurung et al. 2008). Aside from predation, unprovoked attacks can also result when the person and animal are intent on using the same space, and the animal attacks when it is not given 'right of way' and the person(s) is unable to scare it off (Quigley and Herrero 2005); no food or other attractant is involved. However, some attacks of this type might also be motivated by defensive instincts, as discussed above. Finally, disease plays a part in some unprovoked attacks, as when rabid wolves (*Canis lupus*) attack humans (Linnell et al. 2002). Wildlife attacks inevitably generate fear and hostility towards the species concerned, which can lead to retaliatory killing of threatened species (e.g. tigers, Inskip et al. 2014). Even among persons who rarely or never encounter a potentially dangerous wild animal, fear of an attack is sufficient to promote negative attitudes towards wildlife (Kaltenborn et al. 2006).

To date, great apes have featured only rarely in published reports of wild animal attacks on local persons, and few attempts have been made to evaluate characteristics of ape attacks (but see Hockings et al. 2010). Like many large mammals, however, great apes increasingly occupy disturbed habitats amid expanding human populations, and consequently come into contact with people more frequently in some areas than previously (Hockings et al. 2015). This increased proximity has led to growing reports of aggressive interactions between humans and great apes, including cases of apes attacking people (Hockings and Humle 2009). The survival of many ape populations requires finding ways for humans and apes to coexist together in shared landscapes. Given the declining conservation status of all great apes (IUCN 2014), and the potential for ape aggression towards people to reduce support for conservation efforts, a greater understanding of ape attacks on humans is needed to inform appropriate conflict mitigation strategies.

Wild great apes sometimes direct aggressive behaviour towards human researchers, often during early phases of habituation. Such aggression does not usually involve physical contact (e.g. charging displays by adult male chimpanzees; Grieser-Johns 1996; McLennan and Hill 2010). However, gorillas undergoing habituation have been known to attack researchers physically, for example, by grabbing their legs and/or biting (Doran-Sheehy et al. 2007; Ando et al. 2008). More serious attacks (i.e. involving biting or beating causing substantial injury or potential loss of life) on researchers by wild great apes have been reported only very rarely (see Kutsukake and Matsusaka 2002 for an incident involving an unhabituated female chimpanzee; and see White and Edwards 2000 p. 60 for an attack on a researcher by a lone silverback gorilla). Attacks on persons by rehabilitated ex-captive great apes have occurred following their release into natural environments (e.g. orangutans: Yeager 1997; Dellatore 2007), including serious attacks by rehabilitant chimpanzees (Borner 1985; Agoramoorthy and Hsu 1999). However, attacks by ex-captive apes are likely related to their loss of fear of humans, while serious attacks on

researchers by wild apes appear precipitated by unusual circumstances (see above references). Therefore, in this chapter we focus exclusively on aggressive interactions between wild great apes and local persons. First, we review reports of aggression towards humans, including physical attacks, and evaluate their likely causes and contexts. We consider potential differences among great ape taxa in their propensity to attack humans and possible reasons for variation. Finally, we consider great ape attacks in relation to recent developments in the human–wildlife conflict literature, and discuss how a detailed understanding of the contexts of attacks, along with a better understanding of human cultural attitudes and practises and human–human conflict, are important to inform appropriate strategies to reduce likelihood and impact of attacks.

Great Apes and Humans

The nonhuman great apes (hereafter 'great apes')—chimpanzees (*Pan troglodytes*), bonobos (*Pan paniscus*), gorillas (*Gorilla* spp.) and orangutans (*Pongo* spp.)—are widely used as charismatic mega-fauna for conservation. All great ape species and subspecies are listed as Endangered or Critically Endangered by the International Union for the Conservation of Nature (IUCN 2014). A mere estimated 300,000–400,000 individuals of all great ape species remain in the wild with most populations declining due to habitat loss, hunting and disease (IUCN 2014; Rainer et al. 2014). With rapid human population growth in ape range counties, these threats show no sign of slowing down. It has been predicted that by 2030, less than 10 % of African and 1 % of Asian great ape habitat will remain undisturbed from human activities such as logging, mining, agriculture and infrastructural development (GLOBIO model analysis, Nelleman and Newton 2002; see also Junker et al. 2012 for African apes and Struebig et al. 2015 for orangutans). Today, most long-term great ape research sites are impacted by humans and their activities in one way or another (Hockings et al. 2015). Great apes require large spaces yet are increasingly forced into fragmented and restricted ranges, often outside of protected areas (e.g. West African chimpanzees *P. t. verus*: Kormos et al. 2003; Bornean orangutans *P. pygmaeus*: Wich et al. 2012). Consequently, over the coming years and decades we can predict rising levels of contact between humans and great apes, with inevitable increases in negative interactions arising from competition for space and resources, as well as conflicts among different human groups over management of great apes (see section 'Mitigating Conflicts Caused by Attacks').

While persistence of great apes in heavily modified human-dominated habitats is largely a contemporary phenomenon, humans and great apes have a long history of coexistence in some regions. For example, at Lopé, Gabon, humans have coexisted with chimpanzees and gorillas for at least 60,000 years (Tutin and Oslisly 1995). As our closest living relatives, great apes share with us a suite of morphological, behavioural and cognitive similarities, which are widely recognised by local human communities familiar with these animals (e.g. Sept and Brooks 1994;

Sicotte and Uwengeli 2002; Lingomo and Kimura 2009; Sousa et al. 2014). In areas where apes are heavily hunted, they are unlikely to persist in very close proximity to human settlements. However, in some human cultures great apes are afforded special significance that promotes tolerant attitudes towards them; for example, apes are sometimes offered protection from hunting or persecution due to religious beliefs (orangutans: Abram et al. 2015) or local taboos and/or totemic beliefs that consider them ancestors (chimpanzees: Yamakoshi 2005; gorillas: Etiendem et al. 2011). Perhaps not surprisingly, great apes feature prominently in stories and folk-tales of some human societies that have traditionally coexisted with apes. Notably, such stories often allude to the formidable strength and potential dangerousness of sympatric apes (Richards 1995; Köhler 2005; Giles-Vernick and Rupp 2006; Thompson et al. 2008; Oishi 2013).

Variation in Ape Attacks on Humans

Chimpanzees

Considerably more data are available on wild chimpanzee–human interactions than for other great apes. Chimpanzees are sympatric with humans throughout much of their range in equatorial Africa. In areas where human population density is relatively low and encroachment on natural habitat is not extensive, interactions between people and chimpanzees are largely neutral (e.g. parts of West Africa: Dunnett et al. 1970; Leciak et al. 2005; Duvall 2008; Hockings and Sousa 2013). But where human population densities are higher and chimpanzees are not hunted for food, they can persist in highly fragmented and degraded habitat alongside human farming communities (e.g. Uganda: Reynolds et al. 2003, McLennan 2008; Guinea: Hockings 2009; Sierra Leone: Halloran et al. 2014; see also Fig. 1 in Hockings and McLennan 2012). In such circumstances, people and chimpanzees may utilise the same space and resources and encounter one another frequently, inevitably leading to competition and conflict (Hockings and Humle 2009). For example, chimpanzees exposed to agriculture readily learn to exploit some human crops, which can become important items in their diet (Hockings and McLennan 2012; McLennan and Hockings 2014). 'Conflicts' over natural resources, particularly agricultural crops, reportedly occur throughout the chimpanzees' geographical range (Hockings and McLennan 2012).

   Available data imply that a 'habitat disturbance threshold' exists beyond which the frequency of human–chimpanzee contact rises and interactions become increasingly hostile, with both chimpanzees and people directing aggressive behaviour towards the other (McLennan 2008). For example, eastern chimpanzees (*P. t. schweinfurthii*) at Bulindi in the Hoima District of western Uganda inhabit shrinking forest fragments surrounded by farmland and villages. Farmers in this region are traditionally tolerant of chimpanzees, perceiving them to have a 'good' character (Hill and Webber 2010). However, during the past decade forest fragments were

extensively logged and cleared for farming, particularly tobacco cash cropping. Chimpanzee behaviour is perceived by local villagers to have undergone recent negative changes, concurrent with the widespread conversion of forest to farmland, including persistent crop 'raiding' and aggression towards people (McLennan and Hill 2012). Adult chimpanzees directed frequent threatening behaviour towards local persons encountered on farmland and village paths, as well as inside forest, such as charging, mobbing and pursuing them (McLennan and Hill 2010), and showed willingness to engage in prolonged agonistic interactions with humans (for an example, see McLennan 2010a). At the same time, some farmers responded to the rise in encounters with chimpanzees and more frequent crop losses with harassment including shouting, stone-throwing and chasing with dogs (McLennan and Hill 2010). In such circumstances, the likelihood of a chimpanzee attack increases.

Chimpanzee attacks are reported from regions of close human–chimpanzee sympatry in West, East and Central Africa, but details of the surrounding circumstances are often vague or absent (e.g. Mutombo et al. 1983; Richards 1995; McLennan 2008; Halloran et al. 2014). It can be difficult to obtain facts about human or chimpanzee behaviour prior to an attack, in part because people are reluctant to admit any wrongdoing. For example, in Uganda's Hoima District many villagers are aware of the legal status of chimpanzees. Local accounts suggested that two recent attacks in one subcounty 'involved a chimpanzee first being speared or attacked with *pangas* (machetes), or set upon by dogs. In these cases, an attempt may have been made to take an infant chimpanzee from its mother or otherwise confront a crop raiding ape' (McLennan 2008, p. 50). Thus, there was a strong indication that these were 'provoked' attacks. Even so, it is unclear how reliable local reports were.

More detailed accounts are available from several other sites in East and West Africa. Hockings et al. (2010) reported 11 attacks on local persons by chimpanzees (*P. t. verus*) in the heavily human-influenced habitat of Bossou, Guinea, between 1995 and 2009. In 10 of 11 cases, attacks were directed towards children between 18 months and 12 years old. These varied in severity. In three cases, local onlookers reported that injuries were sustained when a chimpanzee dragged the child along the ground during a social display (which functions to intimidate a subordinate or gain rank); when the child's skin was scratched by the ape's sharp fingernails; or when the chimpanzee bit the child directly (Fig. 18.1). Although one child sustained life-threatening injuries, none of the attacks were fatal and none were predatory, which is typically characterised by eating from the victim (cf. Wrangham et al. 2000). Attacks took place on a road and on narrow paths bordering forest, or in cultivated fields and orchards, where opportunities for human–chimpanzee encounters were high. All attacks coincided with wild fruit scarcity, increased levels of crop foraging by chimpanzees, and cropping seasons that likely increased human use of paths. Only one incident was witnessed by researchers. On this occasion, an adult male chimpanzee approached and attempted to take bananas (i.e. an attractant) from a child, but was chased back to the forest by a researcher to prevent a potentially more serious attack. This individual was known to be nearby when other attacks occurred, and due to his confrontational behaviour and general lack of fear of people (chimpanzees at Bossou are well habituated), researchers
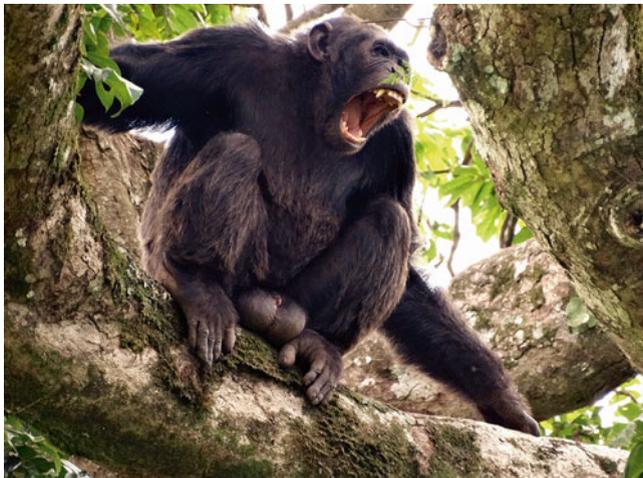
Fig. 18.1 Adult male chimpanzee at Bulindi, Uganda. Chimpanzees have large canine teeth that can inflict severe injuries to victims of biting attacks (Photo: Georgia Lorenti)

strongly suspect this same male was responsible for several other attacks on local persons. In at least some cases, the chimpanzee(s) was probably provoked before attacking (e.g. children throwing stones or carrying food that attracted the chimpanzee). Still, in 8 of 11 cases, it was not possible to confirm exactly why the attack took place. Reasons might include unreported provocation by people, hunger motivating the chimpanzees to feed in agricultural areas thus increasing the likelihood of close range encounters with humans, and adult male chimpanzees asserting their dominance, either to impress conspecifics or assert dominance over humans (Hockings et al. 2010).

Five chimpanzee attacks on children aged between c. 6 months and 6–7 years old are known to have occurred at Bulindi since 2006. These incidents followed extensive clearance of local forests and rise in human–chimpanzee interactions, as detailed above; according to villagers no physical attacks occurred prior to these. While no attack was fatal, in three cases the child sustained serious injuries requiring hospitalisation (McLennan 2010b, and unpublished data). For example, a 4-year-old boy was attacked at a well in a narrow strip of forest. Although local reports varied it appears chimpanzees were travelling past the well when they were 'disturbed' by a group of children; several villagers suggested the children most likely threw stones at the apes. As the children ran away, the youngest child fell down and was grabbed and bitten on the head, foot and below the armpits by a chimpanzee (McLennan 2010b). In at least two other cases, children or young men were alleged to have harassed chimpanzees prior to an attack; thus, these cases were probably 'provoked'. In one case, however, a chimpanzee apparently grabbed and badly mauled a baby which the mother had placed under shade while digging in her field. In at least three cases, the attacking ape was reportedly 'very big' and not closely associated with younger chimpanzees,

suggesting an adult male. As at Bossou, no attack at Bulindi to-date appears motivated by predatory instincts since in no case did the attacking ape eat from the victim or inflict a fatal bite. Reynolds (2005) reported four chimpanzee attacks on children in village areas surrounding Budongo Forest, north of Bulindi, including one which was fatal. No part of the body was eaten in this latter case; however, victims were badly bitten in all cases. Unfortunately, information about human behaviour prior to these incidents is insufficient to reliably categorise them as provoked or unprovoked.

Nevertheless, unequivocal incidents of chimpanzees preying on human children have been documented. Wrangham et al. (2000) reported eight cases over 4 years in which a wild chimpanzee—thought to be a single adult male (Wrangham 2001)—caused severe injury or death to children between the ages of 6 months and 5 years from villages bordering Kibale National Park, Uganda. In all cases, victims were either alone or accompanied only by other children or women. The chimpanzee(s) ate from all victims that could be carried off to an undisturbed site; three children were eviscerated. Injuries to other victims were similar to those seen in monkeys preyed on by chimpanzees (e.g. hands and feet bitten off) (Wrangham et al. 2000). Attacks occurred in a habitat matrix composed of scattered villages, cultivated fields and secondary forest. The chimpanzee(s) exhibited bold behaviour by travelling up to 180 m from the forest edge to capture victims; twice a baby was removed from the doorway of a village house (Wrangham 2001). Two further confirmed incidents of predation occurred in and around Gombe National Park, Tanzania. The first occurred outside the park before 1960 when a male chimpanzee seized a baby from a woman's back, injuring the woman, and killed and partially ate the baby (Thomas 1961 cited in Goodall 1986). A more recent case in 2002 involved a well-habituated and particularly fearless adult male chimpanzee from the main study group in Gombe. This individual approached two women walking through the park and grabbed a 14-month-old baby from one of them; the baby was carried off, killed and partially eaten (Kamenya 2002). Another attack occurred within the park during which a 6-year-old boy was bitten by a chimpanzee and suffered substantial injuries to his face, but it is unclear if this attack was predatory motivated (Goodall 1986). McLennan (2008) reported a fatal attack on a child at a sugarcane plantation near the sparsely forested Kasongoire Forest Reserve, near Budongo, in what might have been a predatory incident. Retaliatory killings of chimpanzees by local villagers are known to have occurred in response to attacks around both Kibale and Budongo (Wrangham 2001; Reynolds 2005).

Gorillas

Western gorillas (*G. gorilla*) coexist with humans in regions across their distribution in the lowland forests of Central Africa (e.g. Etiendem et al. 2011; Oishi 2013). Sabater Pi (1966) reported seven attacks by western lowland gorillas (*G. g. gorilla*) on local persons over a 10-year period at Rio Muni (mainland Equatorial Guinea). Few details of human behaviour prior to these incidents were given; however, most victims were hunters and most attacks seem to have been committed by injured

male gorillas. However, in the most detailed account, a hunter startled a small gorilla group at close range (<5 m) and the (uninjured) dominant male charged and attacked, presumably in defence of the group. Thus, there is no indication that attacks were 'unprovoked' according to Quigley and Herrero's (2005) criteria. Attacking gorillas inflicted severe injuries on victims with their teeth and hands. Sabater Pi concluded that attacks on humans were overall rare considering the frequent opportunities for contact between people and gorillas in local forests and plantations. In a further report, a solitary Cross River (*G. g. diehli*) silverback male attacked an adult man who was setting traps in the Kagwene Gorilla Sanctuary, Cameroon. The man attempted to run and was attacked from behind (A. Nicholas pers. comm. in Hockings and Humle 2009); whether this incident was unprovoked or not is unknown. Elsewhere in southeastern Cameroon, hunters recounted incidents of persons being attacked by gorillas (Oishi 2013). Most attacks seem to have occurred in the context of hunting the apes; however, hunters also claimed gorillas sometimes ambush people unexpectedly in the forest (Oishi 2013).

At a small number of sites in East Africa populations of eastern gorillas (*G. beringei*) live alongside high-density farming communities. Most published data on human–gorilla 'conflicts' are from Bwindi Impenetrable National Park, Uganda, where nearly half of the World's mountain gorillas (*G. b. beringei*) live. Some of Bwindi's gorillas, including groups habituated for tourism, spend a substantial amount of time outside park boundaries where the landscape is dominated by smallholder agriculture and villages, with one habituated group ranging more than 1 km from the park border (Goldsmith et al. 2006). Outside the park, gorillas cause frequent damage to local farmers' crops (e.g. to banana plantations). Additionally, there have been incidents of gorillas attacking people on agricultural land outside the park that left local persons (mostly men) seriously injured. Madden (2006) reported at least eight attacks in two parishes bordering the park during 1996–1998. The attacking individuals were thought to be mature males in all cases, with one individual likely involved in the four cases in one parish. Madden (2006, p. 182) further reported that 'in most cases the offending individuals have been habituated to human presence for the purposes of facilitating ecotourism'. Insufficient information is available to determine whether these attacks were provoked or unprovoked. However, Madden suggested that some attacks may follow from a gorilla being surprised, or being a surprise to, local people.

Bonobos

The geographic range of bonobos is restricted to the central Congo Basin, south of the Congo River. Although in some areas bonobos live in proximity to villages (e.g. at Wamba: Idani et al. 2008; Salonga National Park: Thompson et al. 2008), and reportedly consume agricultural crops at some sites (e.g. Lake Tumba: Inogwabini and Bewa 2009), little published data exist on the nature and extent of human–bonobo interactions. Thompson et al. (2008) reported that the Iyaelima people who live alongside bonobos within Salonga National Park told folk stories of men

fighting physically with bonobos. The Iyaelima claimed to avoid encounters with bonobos, believing the apes can beat up or kill people. However, aside from anecdotes reported in the media (e.g. Catholic World News 2011), no detailed or reliable published data on wild bonobo attacks on humans seem to be available.

Orangutans

Orangutan populations are plummeting throughout their remaining distribution in northern Sumatra, Borneo and Malaysia. They are primarily forest dwellers and were traditionally thought to lack the resilience and adaptability to cope with major habitat disturbance. However, recent studies show that orangutans can persist in degraded habitat including logged forest, plantation landscapes and agroforest systems, indicating greater ecological resilience than previously thought (*P. abelii*: Campbell-Smith et al. 2011; *P. pygmaeus*: Meijaard et al. 2010; Ancrenaz et al. 2010; Ancrenaz et al. 2015). Like African apes surviving in human-dominated habitats, orangutans may enter farmland to feed on cultivated foods (Salafsky 1993; Marchal and Hill 2009; Campbell-Smith et al. 2010); in such areas, they likely have frequent interactions with local human communities. Although ex-captive orangutans are known to attack humans, we are unaware of any published accounts detailing an attack by a wild orangutan on a person. However, Yuwono et al. (2007, p. 21) note that 'this species will not attack people unless it is first provoked, or cornered or otherwise feels threatened'. One case of serious aggression by a wild orangutan against a human occurred in the Sekonyer River area of Tanjung Puting in Central Borneo. A local man was hunting deer when his dogs encountered an adult male orangutan on the ground and chased him. When the man also approached, the orangutan attacked him (Galdikas, pers. comm. 2015). Reports suggest that local people who live in proximity to these great apes consider them dangerous and may fear an attack by wild orangutans (Campbell-Smith et al. 2010). Indeed, in an extensive survey of local knowledge about orangutan killings in Kalimantan, 'self-defence' was the most frequently reported reason for orangutan killings in village areas after hunting for food (Meijaard et al. 2011). And in a related survey, 15 % of respondents who had personally killed an orangutan gave 'fear' or 'self-defence' as the reason for killing compared to 8 % who reported killing one because of crop damage (Davis et al. 2013).

Why Do Chimpanzees Feature Most Prominently in Reports of Great Ape Attacks?

Available data suggest that physical attacks on humans by wild great apes in Africa and Asia are a rare occurrence. For example, at both Bossou and Bulindi where chimpanzee–human interactions have been studied in most detail, attacks occurred less than once per year, even though chimpanzees at both sites encounter local

people daily (Hockings 2009; McLennan and Hill 2010). Despite the rarity of physical attacks by apes, local communities who share landscapes closely with these animals perceive a threat to their personal safety and often fear them (Madden 2006; Campbell-Smith et al. 2010; McLennan and Hill 2012). Evidently, far more published information is available on attacks by wild chimpanzees and, to a lesser extent, wild gorillas compared to the other great apes, bonobos and orangutans. The lack of published accounts of wild orangutan attacks is notable given that, like chimpanzees, orangutans seem able to hang-on in highly disturbed habitats near people, unless persecuted. This indicates that wild orangutan attacks are exceptionally rare, probably because of the relatively peaceful nature of these apes. We found no published information about attacks by wild bonobos, which have been less-studied compared to other great apes. Research on human–bonobo interactions, for example, in areas where bonobos are known to feed on agricultural crops, would be informative in this regard.

The perpetrators of attacks on humans by wild chimpanzees and gorillas seem to be mature males in most cases. However, attack characteristics differ between these African apes. Reports indicate that the target of gorilla aggression is usually an adult (e.g. a hunter) while victims of chimpanzee attacks are overwhelmingly children. Probably, the chimpanzees' smaller body size makes attacks on adult humans risky; unlike captive apes, wild chimpanzees are presumably unaware of their greater strength relative to adult humans (cf. Kabasawa et al. 2008 who report a fatal attack on a man by escaped sanctuary chimpanzees). Gorilla attacks appear most often motivated by defensive instincts, such as when gorillas are wounded by hunters or otherwise perceive the human(s) as a threat. In chimpanzees, the picture is more mixed, with attacks falling into both provoked (i.e. in response to harassment) and unprovoked (e.g. predation or competition for 'right of way') categories. It has been suggested that some wildlife attacks occur when animals lose their fear of humans (e.g. bears *Ursus* spp.; Conover 2002). The perpetrators of some ape attacks were well habituated for tourism or research (e.g. Bwindi gorillas, Bossou chimpanzees). While habituation might make apes less reticent about directing physical aggression towards humans in some situations, it is important to note that many recorded attacks involved semi-habituated (Bulindi chimpanzees) or entirely unhabituated individuals (e.g. predatory chimpanzee(s) at Kibale).

Both gorillas and chimpanzees can inflict severe injuries on victims of attacks (see Khalil et al. 2011 for an assessment of injuries sustained by an adult woman following an attack by a captive male chimpanzee) (Fig. 18.1). However, unlike attacks by some other large mammals (e.g. big cats), attacks by apes rarely cause fatalities. Among great apes, only chimpanzees prey on human children as food. Some bonobo and orangutan populations hunt mammals, including sympatric primates (Surbeck and Hohmann 2008; Hardus et al. 2012). However, hunting and meat-eating—particularly monkey hunting—is overall more prevalent in chimpanzees (e.g. Watts and Mitani 2002). Chimpanzee predation on children represents the most extreme illustration of great ape aggression towards humans. Even so, unequivocal evidence of chimpanzees targeting children as prey comes from two sites only (Kibale and Gombe); no evidence indicates that attacks at Bossou and

Bulindi, among other sites (e.g. around Budongo) were predatory motivated. Therefore chimpanzees' aggressive behaviour may not necessarily lead to predatory attacks, where they encounter children frequently. Hunting frequencies vary among chimpanzee populations as do the prey species available (Newton-Fisher 2007). Notably, neither Bulindi nor Bossou chimpanzees regularly eat meat; at Bossou diurnal primates are absent due to past human hunting activities (Hockings et al. 2012), whereas at Bulindi suitable prey occur (e.g. black and white colobus monkeys, *Colobus guereza*) but no evidence suggests the chimpanzees eat them (McLennan 2010b and unpublished data). Therefore, the risk of predatory attacks against children might be greatest at human-impacted sites where chimpanzees regularly hunt and consume sympatric monkeys. The suggestion that chimpanzee predatory attacks at Kibale were carried out by a single adult male (Wrangham 2001) raises the intriguing possibility that, like some large carnivores, chimpanzees can become 'man-eaters' in exceptional situations.

Why might chimpanzees show a greater propensity to attack humans than other great apes? Opportunity may be part of the answer. Compared to gorillas, bonobos and orangutans, chimpanzees have a broader geographical distribution and exploit a wide variety of habitat types including dense lowland rainforest, dry savanna woodland, and montane forest. This ecological flexibility may equip them with the resilience to cope with human disturbance better than other great apes (McLennan and Hockings 2014). Even so, most reports of chimpanzee attacks come from areas in East Africa where apes aren't traditionally eaten or parts of West Africa where cultural taboos limit hunting, enabling chimpanzees to live in close proximity to local human communities (Hockings and McLennan 2012) (Fig. 18.2). By contrast,
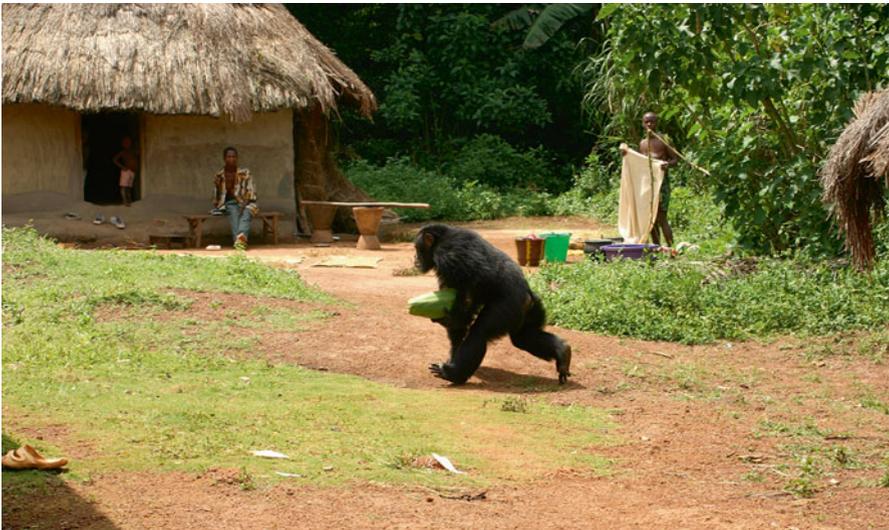
Fig. 18.2 An adult male chimpanzee at Bossou in Guinea crossing a village homestead having 'raided' a papaya fruit. Such close interactions between chimpanzees and people are not uncommon in areas where the apes are not hunted, and where human settlements and agriculture encroach on chimpanzee habitat (Photo: Kimberley J. Hockings)

bonobos and western gorillas are found in Central Africa where human societies tend to occur at lower densities and are more likely to hunt apes, limiting opportunities for close coexistence. In Sumatra, Borneo and Malaysia large-scale commercial agriculture, particularly of oil palm, is the predominant land-use activity around many orangutan habitats (Nantha and Tisdell 2009; Struebig et al. 2015). Guards and workers in these plantations are often men. In contrast, small-scale agriculture characterises most areas of human–chimpanzee sympatry in Africa. In these landscapes, young children commonly guard crop fields and collect water from forest wells, elevating the risk of aggressive encounters with chimpanzees.

From a comparative behavioural perspective, chimpanzees display more frequent aggression to one another as a normal aspect of social life compared to other great apes (Wrangham and Peterson 1996; Wilson et al. 2014). Thus, they can be considered more aggressive generally. Moreover, chimpanzees kept in captivity can be notoriously dangerous to humans (Kabasawa et al. 2008; Khalil et al. 2011). Wild chimpanzee social systems are characterised by strong male bonds, and aggressive confrontations with local people might be a means for adult males to display boldness and assert dominance in front of other males; at the same time, group males might also provide coalitionary support during aggressive interactions with humans (for an example, see McLennan 2010a). This contrasts with other great apes in which males are either more solitary (orangutans), social groups include a single or small number of adult males (gorillas) or males show comparatively weak bonds (bonobos).

Mitigating Conflicts Caused by Attacks

Understanding Great Ape Attacks in the Context of Human–Wildlife 'Conflict'

Hockings and Humle (2009, p. 1) defined human–great ape conflicts as 'any human–great ape interaction which results in negative effects on human social, economic or cultural life, great ape social, ecological or cultural life or the conservation of great apes and their environment'. Definitions of human–wildlife conflict vary but are often constructed in a way that sets animals in conflict with people (Redpath et al. 2014). Redpath et al. (2014) have questioned whether such definitions encourage the misidentification of the antagonists in conflict situations, thereby reducing the likelihood of finding effective mitigation solutions. While the term 'human–wildlife conflict' has become commonplace in discussions of human–wildlife interactions, it obscures the underlying 'human–human conflicts' that stem from differential goals, perceptions and power relations among the human groups concerned (Madden and McQuinn 2014; Marchini 2014; Hill 2015). By directing focus wholly on the proximate factors of a conflict (e.g. wildlife attacks), we risk ignoring underlying social factors that might be driving it (Dickman 2010; Redpath et al. 2013). For example, Redpath et al. (2014) reviewed recent articles dealing with 'human–wildlife conflicts'. Most animal species involved were predators or large herbivores, mostly of conservation concern, and almost all underlying conflicts were between

those who sought to defend conservation objectives and those defending other objectives, mainly livelihoods and human safety.

To avoid misunderstandings in discussions about wildlife attacks, we should differentiate between (1) the direct impacts of attacks on humans, and (2) conflicts among those humans defending the wildlife, including conservation practitioners, and those defending other positions, such as local community members, and be open about the different interests involved in the conflict (Young et al. 2010; Redpath et al. 2014). Gorilla attacks around Bwindi provide an illustrative example. Fear of attack was reported by villagers to impede their activities and movements; for example, some farmers were afraid to work in their gardens and children were afraid to walk to school. Household economics were also affected when individuals injured by gorilla attacks, usually men, were unable to work (Madden 2006). The perceived lack of support from park authorities inflated feelings of ill-will among some community members towards the gorillas and the park generally. As Madden (2006, p. 184) points out, 'the threat of attacks and [crop] raids is also a constant reminder to local people that they lack empowerment under existing government wildlife laws, and that many individuals and families are continually at risk of suffering harm due to gorillas that far outweighs any benefits they may receive from the park's community-oriented revenue sharing programme' (for similar arguments, see also Laudati 2010; Tumusiime and Svarstad 2011). Such issues raise difficult ethical questions regarding promoting human–ape coexistence, where they encounter each other regularly (see McLennan and Hill 2013 for detailed discussions of the ethics of great ape conservation in human-dominated landscapes).

Mitigating Human–Ape Impacts

Mitigating conflicts involving humans and great apes presents challenges because some interest groups seek to conserve great apes while others who are negatively affected by the conflict (e.g. local people) may want them removed or eliminated. Like other large-bodied mammals, due to the size and strong physical presence of apes, fear of physical harm can be a strong driver of conflict (McLennan and Hill 2012; Hockings et al. 2014). Culturally sensitive conservation actions to promote coexistence should therefore aim to foster tolerance and reduce fear, through promoting or developing existing positive attitudes towards apes, while working with people to develop practical measures to reduce encounters and prevent them from escalating into aggressive events (see below). Conflicts can escalate when local people feel that the needs or values of wildlife and/or other human groups, such as the government or tourists, are given priority over their own needs. As illustrated by the Bwindi example above, this is especially applicable when people believe they have little to gain and much to lose by living alongside protected and high-profile wildlife including great apes (McLennan and Hill 2013).

Selective removal of 'problem' apes, i.e. aggressive adult males, as occasionally advocated in conflict situations for other species (e.g. male Asian elephants;

Sukumar 1991) is not appropriate in most situations because of the Endangered or Critically Endangered status of all great apes (IUCN 2014). At Kibale, where the predatory attacks were thought to be committed by a single adult male chimpanzee, removal was considered the best option; however, the male responsible for the final attack was ultimately tracked down and killed by local people before the authorities could intervene (Wrangham 2001). Translocation of problem apes, as has been attempted with mixed success with problem tigers (Goodrich and Miquelle 2005) and leopards *Panthera pardus* (Athreya et al. 2011), is unlikely to be a feasible option for a variety of reasons including the cost and practicalities involved in relocating wild great apes, the difficulty of finding alternative suitable habitats away from humans, and the impact that removal of individuals (e.g. adult males) might have on group social dynamics. Providing financial compensation to victims of ape attacks is likewise complicated. Unless administered carefully, compensation for problematic ape behaviour (including crop damage) can create the perception of 'ownership' of wild apes, for example, by conservation organisations or research teams. Following chimpanzee attacks on children at Bossou, immediate medical expenses were provided to the victim's families as a sign of good will, although it was emphasised that the researchers were not responsible for the chimpanzees or their actions (Hockings et al. 2010).

Land-use changes: The regular cutting back of vegetation along edges of fields, paths and trails frequented by both humans and apes might decrease the incidence of surprise encounters in potentially high-risk areas, thus reducing the likelihood of an animal attacking in response to a perceived human threat. If local people encounter apes most frequently in specific locations to which the apes are drawn, such as a fruit tree, removing or repositioning the attractant outside of the apes' ranging area can reduce the likelihood of encounters. For example, removal of papaya trees in proximity to houses at Bossou successfully reduced chimpanzee forays into people's homesteads, and hence the likelihood that chimpanzees would encounter children (Hockings 2007). Most traditional barriers such as trenches or fences do not deter apes from crossing into agricultural areas or homesteads, and electric fences are expensive and difficult to maintain, and impractical in forest–farm mosaics where crop fields are scattered among forest patches (cf. Honda et al. 2009). Establishment of buffer zones of open land or difficult-to-cross vegetation (e.g. tea) might block or restrict ape travel routes through agricultural land and reduce human and ape encounters (Hockings and Humle 2009). However, where there is limited land for farming and little remaining forest, spare land to create such buffers may be unavailable and apes might have no choice but to cross farmland when travelling among fragmented forest patches (e.g. chimpanzees at Bulindi; McLennan 2010b). Cash crops (e.g. tea, tobacco) and food crops (e.g. vegetables such as potato, onion, cabbage) that are seemingly seldom or never exploited by chimpanzees, including crops they are either unpalatable or inedible when raw (e.g. chilli), could potentially act as economically viable buffers to lessen ape movements into fields and villages (see Hockings and McLennan 2012). Nevertheless, some such crops are associated with increased deforestation of chimpanzee habitats (e.g. tobacco in Uganda;

McLennan 2008). Therefore, the utility of particular crops to help reduce encounters between people and great apes must be carefully balanced against their environmental impact (Hockings and McLennan 2012).

Changing human behaviour: Education programmes should provide informed advice to local people on 'best practice' when encountering great apes to avoid the likelihood of encounters escalating into aggression. In general, people (especially children) should never deliberately provoke apes by throwing sticks or stones, firing gunshots or slingshots, or chasing them with dogs. People often panic upon encountering an ape, and human infants and young children are sometimes left behind by fleeing adults or older children (Hockings et al. 2010; McLennan 2010b), leaving younger children vulnerable to attack. For gorillas, standing up while avoiding eye contact, while holding onto another person, can prevent a charge (Doran-Sheehy et al. 2007). The worst reaction is for a person to run away, as this can provoke an ape to charge, potentially leading to grabbing and biting (Hockings and Humle 2009). Adult male chimpanzees are less likely to confront men than women and children (Wrangham 2001; Hockings et al. 2010; McLennan and Hill 2012), so where possible, adult men should take a lead position when walking through forest or along paths. Children living in proximity to great apes should not be left unsupervised near forest edges, including on agricultural land, and should not venture alone into the forest.

Measures employed by different groups of people to deter apes from entering villages or agricultural areas vary, as do their effectiveness. Around Budongo, guarding of fields, involving regular patrolling of field perimeters by a male guard armed with a stick, was highly effective (albeit time consuming) for deterring chimpanzees (Hill and Wallace 2012). However, other commonly used techniques including shouting, banging objects, throwing stones and using dogs can provoke ape aggression, as noted above—especially if used by children. We acknowledge that these ideals may be hard for some households to put into practice since having children guard crops or fetch water (while adults engage in other tasks) is common in rural Africa.

Concluding Remarks

Physical aggression towards humans by wild great apes in Africa and Asia is overall rare, especially considering that people and apes encounter each other daily at some sites. Compared to other great apes, however, attacks by chimpanzees in areas of high human–ape spatial overlap stand out as a relatively predictable, if infrequent, occurrence. In addition, chimpanzee attacks are more likely to be unprovoked and may involve predation on human children. Unfortunately, detailed information on the circumstances surrounding ape attacks is often lacking. Owing to ongoing human encroachment and modification of great ape habitats, we predict rising levels of contact between humans and great apes in the future. To establish appropriate mitigation

strategies that facilitate sustainable human–great ape coexistence, attacks need to be documented thoroughly and objectively. These data should be combined with further research into the relative effectiveness of different mitigation actions, information on the cultural value of great apes to local people and an increased understanding of underlying conflicts among the different human stakeholder groups.

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