CHAPTER 2

Why conserve primates?

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2.1 A basic question

Most primate populations are declining in numbers and many primate species are under threat of extinction for a variety of reasons, including hunting, disease, climate change, and the loss, degradation, and fragmentation of their habitats (Cowlishaw and Dunbar 2000; Schwitzer *et al.* 2014). For some, this knowledge alone is sufficient reason to conserve primates—it both provides a clear justification for conservation and implies a moral obligation to do so. This view is not universally held, however, and it is therefore important to consider explicitly various answers to the very basic question: why should we conserve primates?

Readers of this book likely require little convincing that non-human primates (hereafter 'primates') deserve targeted conservation attention. Many of us first became involved in primate research because of a deep concern for wild primate populations and a desire to contribute positively to their conservation. Others have become more involved in primate conservation over time, perhaps due to threats to their own study populations or in response to accumulating knowledge of the increasingly dire status of many primate species. Still others may

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be relatively new to the topic, but have strong convictions about the importance of primate conservation. Whatever our personal motivations may be, we will encounter individuals, organizations, companies, and governments that do not share our values. We may be challenged by fellow conservationists who disagree with us about the importance of protecting primates over other taxa, activists that remind us that our proposed conservation actions may have negative consequences on local people, or government officials who argue that economics and development trump all other concerns. In such situations, inability to provide a convincing answer to the simple question of why we should conserve primates will likely doom our efforts to failure before they begin.

In this chapter we summarize several justifications for conserving primates. Our goal is to compile general information that will help primate conservationists make strong cases for the need to engage in specific conservation actions aimed at protecting particular primate populations in particular places. Not all arguments will work in all instances, of course, and there is no substitute for a well-considered, creative, and site-specific justification to support a particular policy. Nevertheless, some of the general points considered here may bolster specific arguments. We present eight broad justifications for conserving primates, starting with those that are most anthropocentric and progressing to more biocentric ones. After considering these justifications, we discuss some factors that complicate attempts to make convincing arguments in favour of primate conservation.

2.2 Primates promote human health

Primates have long been considered crucial to research that improves human health. Although primates comprise a small proportion of animals used in biomedical work, their close genetic and physiological similarity to humans makes them uniquely valuable in developing treatments for and vaccines against human illnesses (Bontrop 2001; Carlsson *et al.* 2004; Sibal and Samson 2001). Indeed, researchers studying a wide range of diseases and disorders consider primates to be irreplaceable to research that is ultimately aimed at enhancing human health and wellbeing (Bennett 2015; Capitanio and Emborg 2008; Evans and Silvestri 2013; Joyner *et al.* 2015; VandeBerg and Zola 2005). Most primates used in biomedical research are bred in captivity for this purpose (California Biomedical Research Association 2015). Nevertheless, wild populations are still occasionally used as source populations in exceptional cases where captive-bred primates are inappropriate (e.g. Home Office 2004; United States Department of Agriculture 2013). The escalating threat from emerging infectious diseases and the rapidly changing environmental conditions resulting from global climate change may increase the importance of wild primate populations as sources of research subjects. For example, primate populations that harbour natural immunity to novel pathogens may provide unique insights that help fight future human diseases. The extinction of wild primate populations could mean the loss of information vital to human survival in a future of emerging infectious diseases and global climate change.

2.3 Primates provide benefits to local communities

Wild primate populations can provide important benefits to people living in proximity to them. In some areas, primates and other sources of wild meat can serve as important food resources for communities living inside or adjacent to tropical forests (Brashares *et al*. 2011; Millner-Gulland *et al.* 2003). For example, consumption of meat from wild animals, including primates, was associated with substantially reduced incidence of anaemia in children living in villages around the Makira Protected Area in northeastern Madagascar (Golden *et al.* 2011). Such hunting is, however, usually unsustainable (Cowlishaw and Dunbar 2000; Fa *et al.* 2002, 2005; Fa and Tagg, Chapter 9, this volume; Golden 2009) and can lead to local extinction of species (Nunez-Iturri *et al.* 2008). Nevertheless, truly sustainable management of primate populations for food would, by definition, ensure their long-term persistence and therefore could conceivably be used as a justification for primate conservation under certain, special circumstances (Cowlishaw and Dunbar 2000; Crockett *et al.* 1996; de Thoisy *et al.* 2009; Ramirez

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1984). This argument is, of course, incompatible with some alternative justifications for their protection (e.g. those that invoke the intrinsic value of life, Section 2.9), highlighting the complexities inherent to most conservation and reminding us that groups that share a common goal may do so for very different reasons.

In some areas, conservation of a particular primate population might provide economic benefits to local communities (Siex and Struhsaker 1999; Davenport *et al.* 2002). For example, substantial revenue is generated in some communities from primate and rainforest tourism (Adams and Infield 2003; Archabald and Naughton-Treves 2001; Kirby *et al.* 2010); such tourism may in turn promote conservation under certain circumstances (Pusey *et al.* 2008; Kirby *et al.* 2010; Savage *et al.* 2010).

In addition to tangible benefits they may provide, primates may have cultural or religious significance for people living in nearby areas (Fuentes and Wolfe 2002; Riley 2010; Humle and Hill, Chapter 14, this volume). For instance, the Hanuman langur in India is considered holy in the Hindu religion and the Iyaelima people in the Democratic Republic of Congo have taboos that prevent them from eating bonobos (Fuentes and Wolfe 2002). In such instances local people have likely been living in close proximity to wild primates for millenia (e.g. Tutin and Oslisly 1995), and in some cases can be powerful advocates for primate conservation.

Thus, for local people, extinction of nearby primate populations could reduce sources of wild meat, decrease economic opportunities, or erode deeply held cultural beliefs.

2.4 Primates serve key ecological functions

Primates often perform critical ecological functions in the ecosystems they inhabit. First, primates provide pollination services in some ecosystems (Carthew and Goldingay 1997; Gautier-Hion and Maisels 1994; Janson *et al.* 1981). For instance, Kress *et al.* (1984) conducted a detailed study of the relationship between the traveller's tree (*Ravenala madagascarensis*) and ruffed lemurs (*Varecia variegata*) and concluded that the system showed features of a co-evolved plant–pollinator relationship. Second, primates are widely acknowledged to be important seed dispersers (Chapman 1995; Lambert and Garber 1998; Norconk *et al.* 1998; Sato 2102; Tutin *et al.* 1991). In some plants, seed germination rates are positively influenced by passage through the primate gut; other plant species depend solely on primates for dispersal (Chapman and Onderdonk 1998; Wrangham *et al.* 1994). There is mounting evidence that local extinction of primates substantially alters plant species composition (Effiom *et al.* 2013a; Nunez-Iturri *et al.* 2008; Vanthomme *et al.* 2010). Third, primates are important seed predators in some ecosystems (Peres 1991; Peters 1993; Norconk and Veres 2011), and while it has to date received little attention, it is possible that primate seed predators may help maintain plant species diversity by disproportionately preying on seeds of common plant taxa (cf. Paine and Beck 2007; Power *et al.* 1996; Terborgh 2012). Fourth, folivory by primates can affect the mortality, fecundity, and growth rates of tree species (Chapman *et al.* 2013). Fifth, the presence of primates can influence community structure across multiple trophic levels. For example, the loss of primates due to hunting in Nigerian tropical forests has resulted in changes of the relative abundances of other mammals, with cascading effects on plant communities (Effiom *et al.* 2013b). Sixth, primates are important prey species in some ecological communities (Isbell 1994; Hart 2007); some species, most notably chimpanzees, can also have considerable impacts as predators on primates and other animals (Stanford 1995; Teelen 2008). Finally, primates may play a role in buffering against the detrimental effects of global climate change. Primates are typically the key dispersers of larger-seeded plant species (Howe 1986), and large-seeded tree species often have higher carbon densities than trees with small seeds (Queenborough *et al.* 2009; Wright *et al.* 2007). Thus, the presence of primates promotes the sequestration of additional carbon in tropical forests, which serve as key buffers against global climate change (Van der Werf *et al.* 2009).

These examples demonstrate that primates play an important role in maintaining well-functioning ecosystems. It has generally been difficult to determine whether primates serve keystone functions in ecological systems, in part because it is unclear to

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what extent the ecological roles of primates would be filled by other taxa were primates absent (e.g. Chapman and Onderdonk 1998; Gautier-Hion *et al.* 1985; Poulsen *et al.* 2002; Russo and Chapman 2011; Chapman *et al.* 2013). Mounting evidence suggests, however, that at least in some systems primates serve uniquely important roles, and that their loss has large effects that are not offset by other taxa (Effiom *et al.* 2013a, b; Muller-Landau 2007; Nunez-Iturri *et al.* 2008). Primate conservation is therefore crucially important to maintain intact ecosystems and the many services these ecosystems provide to people, including clean and stable water supplies, prevention from floods and landslide, pollination, stable micro-climates, and buffering of global warming (Wich *et al.* 2011).

2.5 Primates provide unique insights into human evolution

Humans are primates and therefore the protection of wild primate populations preserves our ability to study the ecology, sociality, and behaviour of our close relatives (Boyd and Silk 2012; Fleagle 2013). A deep understanding of humans is impossible without placing our evolution, biology, and culture in broad phylogenetic context. Extinction of a primate species would diminish our capacity to understand ourselves, our evolution, and our place in nature. For example, consideration of humans in the context of non-human primates has enhanced our understanding of human cognition (Matsuzawa 2001; Tomasello 2009), genetics (The Chimpanzee Sequencing and Analysis Consortium 2005; Patterson *et al.* 2006), communication (Savage-Rumbaugh *et al.* 1998; Tomasello 2008), aggression (Smuts 1992; Wrangham and Peterson 1996), reconciliation (Aureli *et al.* 2002; de Waal 2000), ecology (Hill 1982; Ulijaszek 2002), and much more. Studies of extant primate tool use, hunting, cultural traditions, and diet importantly inform reconstructions of human evolution (e.g. McGrew 1992; van Schaik *et al.* 1999; Matsuzawa 2001; Boyd and Silk 2012). For this reason, most primatologists in the United States, and many in Europe and Japan, are affiliated with academic departments or institutes primarily dedicated to the study of anthropology and human evolution.

Study of great apes has been of particular interest, given their close phylogenetic relatedness to humans (de Waal 2005; Knott 2001; Semendeferi *et al.* 2002; Wrangham 1987; Wrangham and Pilbeam 2001), but other taxa have also been argued to provide valuable insights into the evolution of human behaviour (DeVore and Washburn 1963; Kinzey 1987). Loss of any primate species, but especially an ape taxon, would both hamper our ability to distinguish homologies (characters shared based on common descent) from homoplasies (characters evolved independently through convergence) in hominoid evolution and limit our understanding of the range of variation possible in some traits. For instance, consider how different our understanding of ape social relationships, aggression, and dominance would have been had bonobos gone extinct before they were studied in the wild. Bonobos exhibit several features that contrast starkly with general patterns seen in other great apes: bonobo females are more social, form stronger bonds with one another, and are subject to greatly reduced threats of sexual aggression or infanticide compared to other apes (Hare *et al.* 2012; Stumpf 2006; Surbeck *et al.* 2012). These observations helped spark investigation of and appreciation for the importance of female social relationships and the social function of sexuality in apes, thereby broadening conceptions of the range of variation possible in the lineage producing chimpanzees, bonobos, and humans (Kano 1992; Parish 1994; de Waal 2005). Conserving primates preserves precious information about ourselves and our past.

2.6 Primates are of immense biological interest and importance

The primate order is a diverse group and exhibits substantial variation in ecology, social system, and behaviour (Smuts *et al.* 1987; Kappeler 1999; Mitani *et al.* 2012; Rylands and Mittermeier 2014). Primate species span at least four orders of magnitude in body size, consume a wide variety of diets, exhibit the most diverse set of locomotor adaptations of any animal order, live in many types of social system, and inhabit a range of environments (Clutton Brock 1989; Fleagle 2013; Rowe and

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Myers 2015; Wright 1999). This variation presents a treasure trove of raw material that biologists can explore to promote our general understanding of how morphology, sociality, and behaviour evolve under a range of ecological conditions. Of particular interest are questions regarding how different species adapt to the same conditions (e.g. studies of primate communities, examination of different responses to environmental change and habitat degradation) and how the same species adapts to different conditions (e.g. documentation of variation in behaviour, sociality, and life history across environmental gradients). Extinction of primate species and loss of populations will hamper our ability to make sense of the natural world and elucidate general biological principles that apply to many other taxa.

The crucial role of primates in furthering biological understanding is especially evident when one considers our general ignorance of the tropics. The tropics house the majority of the world's biodiversity (Ceballos and Ehrlich 2006; Kreft and Jetz 2007) and yet for many groups we lack even the most basic understanding of their diversity, biology, or conservation status. For example, in amphibians a much larger proportion of tropical species than temperate species are classified as data deficient by the IUCN (Collen *et al.* 2008; Stuart *et al.* 2004), a pattern that appears to be true of other taxa as well (e.g. mammals: Schipper *et al.* (2008); birds: Butchart and Bird (2010)). Against this backdrop of general ignorance about the tropics, primates stand out as a relatively well-studied group, in part because many species are gregarious, diurnal, and relatively easy to study in the wild (Emmons 1999; Harcourt 2000, 2006; Beaudrot *et al.* 2013). In a recent study of research conducted in tropical protected areas, Marshall *et al.* (2016) found that 47.5% of all works returned by a Google Scholar search of the names of all terrestrial protected areas in great ape range countries concerned primates, compared to 23.6% for other mammals, 5.9% for birds, 11.3% for plants, and 11.7% for other taxa. This suggests that, at least in the paleotropics, much more scientific research is published on primates than any other taxon.

Research on primates often sheds light on other taxa inhabiting the same forests, thereby raising our general understanding of the tropics. For instance, *Cola lizae*, a tree endemic to Gabon that was long known locally as an important timber species, was only recognized as a species in 1987 when discovered by primatologist Liz Williamson, for whom the tree is named (Hallé 1987). Research by primatologists demonstrated that the tree is only dispersed by gorillas, despite being fed on by many primate species (Tutin *et al.* 1991). Were gorillas to be lost from these forests, an important resource (as food for frugivores and timber for people) would be lost—an insight gained only through the work of primatologists. Primatologists have discovered other ecologically important relationships between primates and other forest species (see Section 2.4). Protection and study of primates is therefore vitally important to promote our biological understanding of some of the most diverse and least understood communities on Earth.

Merely protecting primate species from extinction is inadequate to preserve their value as subjects of biological investigation. Alteration and degradation of primate environments and loss of populations permanently reduces our ability to understand basic aspects of their behaviour, ecology, and adaptability (Caro and Sherman 2011). Studies of primate taxa in distinct environments have demonstrated considerable within-taxon variation in diet, life history, ecology, sociality, and behaviour (e.g. baboons: Kamilar (2006); orang-utans: van Schaik *et al.* (2009); red colobus: Struhsaker (2010)). Such variability is likely quite common in primates (see Groves, Chapter 4, this volume), suggesting that extinction of local populations will result in permanent losses of diversity (Caro and Sherman 2012). This reduction of diversity will not only reduce our ability to understand the biology and ecology of wild primates; it may also remove from a species' behavioural repertoire the ability to adapt to climate change, or eliminate from a species' gene pool resistance to emerging infectious diseases. Therefore, preserving populations across the full range of environments that a primate species occupies and protecting at least a portion of each habitat type from degradation is necessary to capitalize fully on the scientific value of primates as subjects of biological study.

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2.7 Primates may promote conservation of other taxa

Primates can serve as important surrogate species (*sensu* Caro 2010) that contribute positively to the conservation of other taxa by acting as flagship, umbrella, or indicator species. Many primate species are charismatic, emotionally evocative, and interesting to people (e.g. Nishida *et al.* 2001; Wrangham *et al.* 2008; Meijaard *et al.* 2012) and can therefore serve as effective flagships that raise awareness, funds, and support for conservation actions that protect multiple species (Alexander 2000; Clucas *et al.* 2008). Some primates may also serve as classic umbrella species, meaning that the protection of sufficient habitat to secure long-term viability of the primate taxon also ensures persistence of other threatened species (Caro 2003, 2010). This is most likely to be true for large-bodied species that live at relatively low population densities and therefore need large blocks of habitat to ensure the demographic and genetic health necessary for long-term persistence (e.g. orang-utans: Marshall *et al.* (2009)). Finally, primates have been argued to be valuable indicator species (Hill 2002), because their species richness serves as a surrogate for diversity in other taxa or because the health of their populations reflects the general health of an ecosystem.

In addition to the potential value of primates as surrogates, their presence at particular sites can promote conservation of sympatric taxa. It has become increasingly appreciated that researchers provide direct conservation benefits at the sites where they work by promoting awareness of the value of the natural world, training the next generation of scientists and managers, building capacity, facilitating law enforcement, and providing alternative sources of income to people who may otherwise engage in activities detrimental to biodiversity (Paaby *et al.* 1991; Wrangham 2008; Campbell *et al.* 2011; Sekercioglu 2012; Laurance 2013). The presence of charismatic taxa, such as apes, attracts researchers and the positive conservation effects of their attention (Magin *et al.* 1994; Sitas *et al.* 2009; Marshall *et al.* 2016). In essence, then, primates attract researchers, and researcher presence provides a protective umbrella that promotes conservation of primate habitats and other taxa inhabiting them.

2.8 Some primates are particularly susceptible to extinction

Many primates exhibit traits that have been shown to increase extinction probability in other taxa. The most important factor predicting extinction risk is small population size because small populations are at high risk of extinction due to demographic, genetic, and environmental stochasticity (Soulé and Wilcox 1980; Soulé 1987; Caughley 1994). Primate populations across the globe are shrinking due to habitat loss and degradation, hunting, and disease, and are becoming divided into smaller units by habitat fragmentation. These small primate populations continue to be affected by the deterministic processes that led to their declines, but once small are subject to the additional stochastic effects that magnify extinction risk. Small population sizes are also often linked to small geographic ranges and low population densities, which both significantly increase extinction risk in primates and other species (Purvis *et al.* 2000; Johnson 1998; Harcourt and Schwartz 2001; Harcourt *et al.* 2005; Harcourt 2006). Species with slow life histories are also identified as extinction prone in many analyses (Terborgh 1974; Cox 1997; but see Purvis *et al.* 2000), and primates have famously slow life histories compared to other mammals (Charnov and Berrigan 1993). Large-bodied primates are even more vulnerable to extinction, both because large body size is a strong independent predictor of vulnerability (Purvis *et al.* 2000; Cardillo *et al.* 2005) and because large species, such as great apes, have slow life histories (Wich *et al.* 2004, 2009; Marshall *et al.* 2009). More work is needed to fully understand the factors that predict extinction risk, in part because interpretation of broad comparative analyses of extinction risk is complicated by biases due to missing data (González-Suárez *et al.* 2012). Nevertheless, many primate taxa exhibit multiple traits that consistently predict extinction risk in comparative analyses, suggesting that primates warrant conservation under models that allocate conservation effort based on vulnerability.

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2.9 Ethical arguments

For many people there are ethical reasons to protect primates (e.g. Cavalieri and Singer 1993). Although this sentiment might be more frequently (although certainly not solely) expressed in developed nations (Hill 2002), it is perhaps one of the most fundamental justifications to protect any species. Ethics were an important impetus for the creation of the first National Parks (Callicott 1990) and the founding of conservation NGOs (e.g. WWF: Schwarzenbach (2011)). Primatologists often cite ethical arguments as their personal reason for becoming involved in conservation. Such arguments are often rooted in the belief that all life has equal inherent value and the loss of any species due to human actions represents a failing of our moral obligation to protect species from human-induced extinction (Naess 1986; Hargrove 1989). In addition to their intrinsic value, the fact that primates are our closest genetic relatives and share many other characteristics with humans has been used to bolster ethical arguments for specific conservation efforts for primates, and in particular great apes (Nishida *et al.* 2001; Wrangham *et al.* 2008).

2.10 Complications

Taken together, the arguments reviewed here comprise both compelling justification for primate conservation and imply that we have an obligation to do so. While there are many reasons to protect primates, to be truly effective advocates for their conservation we must be aware of some complications attendant to the justifications discussed above. We consider four of these below. We begin by discussing the basic question of whether primates are uniquely deserving of conservation attention. We then note that some alternative justifications for primate conservation are contradictory, that cultural factors often complicate primate conservation, and that most justifications are unlikely to be successful in every context. We next discuss potential risks to some justifications for primate conservation, and end with a consideration of opportunity costs. These complications do not undermine all justifications for primate conservation, but they do highlight the need to be strategic when applying them.

2.10.1 Are primates special?

Many arguments made in support of primate conservation begin with the tacit assumption that primates are more special, and more deserving of protection, than other taxa. Some of the reasons given as justification are demonstrably true. For example, non-human primates are undoubtedly our closest phylogenetic relatives, and if one accepts the premise that studying other taxa is important to better understand ourselves, then it is difficult to take issue with the contention that primates are special because they provide unique insights into human evolution. Similarly, it is hard to argue that the primates are not among the most well studied of tropical animals and as such are special because they provide a valuable insight into otherwise often poorly known ecosystems.

The contention that primates are special is not, however, always so easy to justify (Lovett and Marshall 2006). One reason for this is that many of the justifications given for primate conservation are not unique to primates. Primates may not be the only, or even the most important, provider of a particular ecological function in some systems (e.g. seed dispersal: Corlett (1998); Stevens *et al.* (2014)). Many primate taxa are threatened with extinction, but it is not always true that they are the most threatened in a particular region or country (e.g. in many places amphibians are more severely threatened than primates: Baillie *et al.* (2004)). And while primates can be important flagship species, they are not the only such taxa (Caro and O'Doherty 1999; Clucas *et al.* 2008) or necessarily the most effective (Bowen-Jones and Entwistle 2002; Smith *et al.* 2012). In other words, primates may not always be *especially* important seed dispersers, *especially* severely threatened, or *especially* effective flagship species. In such cases, basing justification for conservation investment on the contention that primates are special may not be wise or effective.

A second complication of invoking the 'primates are special' argument in support of primate conservation is that individuals may raise principled objections to the focus on any particular taxon. There is a strain of thought in conservation suggesting that all species have the same inherent value and are therefore equally deserving of conservation

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funds (Hargrove 1989; Naess 1986). There is also merit in the argument that conservation should not be principally organized around preservation of particular taxonomic groups, and that we should instead focus on, for example, provision of ecosystem services (Tallis *et al.* 2008), optimal allocation of limited resources (Wilson *et al.* 2006), maximizing preserved phylogenetic diversity (Faith 1992), areas of high endemism and threat (Myers *et al.* 2000), or regions that are otherwise especially vulnerable or irreplaceable (Brooks *et al.* 2006).

We do not wish to undermine the many defensible arguments that can be made in support of the contention that primates are special. Primates *are* special in important ways, and pointing this out can be quite effective in arguing for primate conservation in some contexts. Primates are not, however, special in *all* ways. Uncritical application of the 'primates are special' argument is unlikely to be successful. We should be careful to limit our use of this justification to situations where it is demonstrably true or empirically defensible.

2.10.2 Contradictions, complexities, and limitations

As with many areas of conservation science and practice, contradictions and complexities abound in debates of whether and why to protect primates. Some of the preceding arguments in favour of primate conservation are at odds with one another; others are complex and difficult to apply in specific situations. For instance, ethical arguments invoking our moral obligation not to harm individual primates cannot be easily squared with the perspective that primate populations should be valued for the wild meat that they provide some communities (Hill 2002) or justifications for primate protection rooted in their value for biomedical research. In addition, although not necessarily inherently contradictory (Guy *et al.* 2014), actions to help primates taken in the name of animal welfare (e.g. rehabilitation, release) are often not the most cost-effective or beneficial tactics to promote conservation of wild primate populations or their habitats (Wilson *et al.* 2014; Yeager 1997). Indeed, under some circumstances, actions undertaken to promote individual welfare, such as release of sick individuals into the wild, may endanger wild populations (Harcourt 1987; Bennett 1992).

Complexities arise when the attitudes or cultural beliefs of distinct stakeholder groups clash. For instance, the perspectives of people in high-biodiversity, developing countries are often sharply at odds with the views of conservationists largely based in developed countries that have already substantially degraded their own wildlife (Meijaard and Sheil 2011). Even people living side by side can have very different cultural values and attitudes towards wild primates; some may view them as sacred while others consider them agricultural pests or sources of food (Hill 2002; Humle and Hill, Chapter 14, this volume). This is particularly true in instances of migration, where immigrant communities often lack long-term ownership over the land and consequently have little incentive to utilize it sustainably (Cowlishaw and Dunbar 2000; Ekadinata *et al.* 2013; Levang *et al.* 2007; López *et al.* 1988).

Finally, most justifications used in support of primate conservation will not work in all contexts. For example, tourism is not a panacea. Although tourism can generate income for local communities, complexities and conflicts surrounding such arrangements (e.g. Adams and Infield 2003; Archabald and Naughton-Treves 2001) highlight more general concerns with tourism (Kiss 2004; Weaver and Lawton 2007). It is likely that the conditions necessary to promote successful primate tourism exist at only a limited number of sites. In addition, even when the economics of a tourism operation are effectively designed, it may be inadvisable to develop tourism everywhere because of the risk of transmission of diseases from humans to primates (Goldberg *et al.* 2007; Pusey *et al.* 2008) and the stress that tourism may impose on individuals being observed by tourists (Maréchal *et al.* 2011). Similarly, as discussed elsewhere in this chapter, justifications invoking ethics, spirituality, extinction risk, or biological interest will have different probabilities of success depending on context and the relevant stakeholder groups.

These contradictions, complexities, and limitations highlight the need for tactical, situation-specific justifications for primate conservation. We cannot uncritically apply justifications or approaches that were successful in one context and

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assume they will work elsewhere. Similarly, failure of a tactic or strategy in one context does not necessarily mean that it would not work somewhere else. Primate conservation requires creative, open minds and informed understanding of the cultural, social, economic, and ecological particulars of a given conservation context.

2.10.3 Risky justifications

Some justifications for conserving primates have risks of backfiring: they may be used to support primate conservation in some instances but could be used to argue against it in others. For example, while economic arguments for conservation have the potential to substantively influence policy in ways other justifications cannot (Balmford *et al.* 2002; Pearce *et al.* 2008), they are risky because conservation will not always be the most economically rational choice. Often the deck is stacked against conservation because it is difficult to assess the value of biodiversity benefits and the costs are often ignored (e.g. comparisons of the cost effectiveness of alternative fuel sources typically exclude environmental costs associated with global climate change). In addition, the economic benefits of environmental degradation are usually immediate and reaped by a relatively small set of (typically powerful) individuals, whereas the costs are not fully felt until much later and are often largely born by those who do not share in the benefits (e.g. Balmford and Whitten 2003; Barber and Schweithelm 2000). Even in situations where conditions are conducive to sustainable management, the most economically rational decision may well be to clear cut a forest and invest the funds wisely, rather than protect the forest for the ecosystem services it provides or extract timber in a sustainable way (Alvard 1988; Harcourt 2001). Thus, relying solely on economic arguments in favour of primate conservation, such as touting the potential tourism benefits to local people, runs the risk that an alternative, more lucrative proposal entailing destruction of primate habitat could win out.

Justifying conservation of primates on the basis of their phylogenetic relatedness to humans can likewise backfire. If one argues that protection of primates is important because they are closely related to humans, then a logical retort is that humans must be the most important of all, and therefore steps taken to conserve primates at the expense of people are unjustified. In Indonesia, we frequently encounter people who struggle to understand why so much international funding and attention is devoted to orang-utans when the majority of the people who live in close proximity to them exist on less than USD2 per day (Meijaard *et al.* 2012). In such circumstances it is easy to understand why politicians find it expedient to campaign on platforms that promote helping people, not orang-utans, as a candidate for governor of East Kalimantan, Indonesian Borneo, did in 2008 (Meijaard and Sheil 2008).

Finally, the fact that local communities may have beliefs, attitudes, or practices that appear to be consistent with the preservation of nearby primate communities should not be a cause for complacency. In part, this is because veneration does not necessarily prohibit utilization (Hill 2002) or conflict (Fuentes *et al.* 2005; Fuentes 2012). For example, in the Mentawai Islands, Indonesia, while primates are sacred cultural symbols in art, music, and folklore among traditional communities, they are also frequently hunted and consumed (Mitchell and Tilson 1986). Similarly, although some individual primates are kept as pets and incorporated into fictive kinship systems by the Guaja Indians of Brazil, other individuals of the same species are hunted for food (Cormier 2002; Hill 2002). Also, like other elements of culture, peoples' beliefs and attitudes about primates are not fixed. Species that were once considered sacred may come to be viewed as less so in the face of basic economic needs (Hill 2002; Leach 1994 in Hill 2002; Humle and Hill, Chapter 14, this volume). For instance, the Hindu beliefs that once protected monkeys in rural India have not protected them from persecution when raiding crops in recent decades (Mukherjee *et al.* 1986; Southwick *et al.* 1983). Even when values do not shift, improvements in hunting technology, transportation, and access, or changes in human population density can render unsustainable practices that once were far less damaging (Alvard 1993, 1988; Hames 1979; Harcourt 2001). Thus, the protections afforded by traditional beliefs will not necessarily persist in the face of changing economic conditions or shifting social customs.

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Conservationists, like people more generally, are notoriously reticent to explicitly incorporate the risk of failure into their decisions (Plous 1993; Redford and Taber 2000; Game *et al.* 2013). Nevertheless, selection of justifications for primate conservation must include consideration of the possibility that their invocation may have unwanted effects.

2.10.4 Opportunity costs

Because the resources available for conservation are insufficient to meet all needs, a major focus of conservation over the last several decades has been determining effective, efficient ways to allocate limited resources (Brooks *et al.* 2006; Carwardine *et al.* 2008; Wilson *et al.* 2007). A range of different conservation prioritization strategies have been proposed and implemented, and while they differ in important ways, they all seek to explicitly integrate opportunity costs into conservation decision-making (Game *et al.* 2013; Kirkpatrick 1983; Wilson *et al.* 2006, 2009). Opportunity costs formalize the intuition that investment to address one conservation problem reduces or precludes investment in a different problem; as Game *et al.* (2013: 480) succinctly state: 'every good thing we do is another good thing we do not'. Thus, when we advocate expenditure of funds to conserve primates, we must recognize that resources allocated to primate conservation will often therefore be unavailable to address other conservation goals. It is possible that the conservation funding we seek to help a threatened primate species could be better spent to protect a critically endangered bird, or perhaps the chances of success at protecting our target primate population are so low that a wiser use of funds would be to invest them on a taxon with a more reasonable chance of persistence (Bottrill *et al.* 2008).

Choices among competing conservation demands are not easy to make, but we make them, whether we choose to acknowledge them or not (see Marshall and Wich, Chapter 18, this volume). There are occasionally win–win situations, where investment in a primate species may provide ancillary benefits to other taxa (e.g. when primates are umbrella species), but such instances are probably rarer than we imagine. It is also sometimes true that funding sources are earmarked for a particular taxon, due to interests of private donors, targeted fundraising campaigns, or legislated government policies, and in such cases use of resources to conserve primates may not present opportunity costs for conservation of other taxa. But even in these more targeted instances, it is generally the case that there are not sufficient funds to support all worthwhile primate projects, so consideration of opportunity costs will still be necessary. In such instances, use of formal, quantitative methods provide defensible, rigorous, and transparent algorithms to allocate limited conservation funds (Wilson *et al.* 2007; Gregory *et al.* 2012; Game *et al.* 2013).

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Chapter 2

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