

1 Changing Priorities for Primate Conservation and Research in the Anthropocene

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There is no doubt that the majority of primate species are at a greater risk than ever of becoming extinct. Indeed, as we write this, a formative paper has recently been published outlining that 75 per cent of the world's primates are in steady decline and 60 per cent are threatened (Estrada et al., 2017). These numbers are staggering and confronting on their own, but perhaps are made even more so when comparing them to numbers presented in a pivotal 2001 paper by Chapman and Peres that reported that at the turn of the century only 50 per cent of species were threatened, indicating, regardless of taxonomy, a sharp increase in the number of species on the IUCN Red List in a mere 15 years. In addition, Estrada and colleagues (2017) report regional variation in primate decline, ranging from 36 per cent of primates in the Neotropics to 100 per cent in Madagascar. All of this explains why the IUCN lists Primates as being the order of mammals with the greatest number of species at a higher than average level of threat.

Even the discovery of new species, which used to be cause for celebration, is now also cause for alarm. Most recently, the discovery of the Tapanuli orangutan (*Pongo tapanuliensis*) created both great excitement and concern as it represents an additional species of great ape but was immediately listed as critically endangered due to low population size and extremely rapid habitat loss throughout their range (Nater et al., 2017). This was also the case in 2016 with the discovery of the Skywalker hoolock gibbon (*Hoolock tianxing*) (Fan et al., 2017) that was immediately listed as endangered, and in 2010 with the discovery of another gibbon, *Nomascus annamensis* (Van Ngoc Thinh et al., 2010). Although the latter species has not been formally evaluated by the IUCN it is expected to be listed as endangered as it is currently threatened by hunting and habitat loss throughout its range in Laos, Vietnam and Cambodia. Similar stories ring out on a regular basis from Madagascar, where new species of lemurs are discovered (i.e. *Microcebus ganzhorni* in 2016) just to be immediately placed on the endangered species list. It has thus become apparent that primatologists are being faced with extra challenges of not only learning about the behaviour and ecology of newly described species, but of ensuring these animals are alive long enough for us to be able to do so.

This widespread vulnerability of primates, which could lead to the imminent loss of our closest living relatives, is causing a shift in the way that we, as primatologists, do our jobs. Being driven by the real possibility that we may start witnessing species extinctions in our own lifetimes, we are shifting our research priorities and questions to those that are aimed to answer the question 'How we can slow or stop the loss of

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primates?’ Our research has thus become focused on trying to understand how the major threats to primates, including habitat loss and hunting, are impacting existing populations to determine ways to mitigate the effects. Unlike past generations, we have also had to factor in the impact of climate change, which when acting on top of existing threats, is placing many populations and species in double jeopardy. In essence, such rapid changes to the viability of the majority of the world’s primates have made us rethink our career goals.

When many young primatologists entered the field over a decade ago, including the editors of this book, we were driven by evolutionary questions centred in the field of behavioural ecology and, in fact, likely described ourselves as behavioural ecologists. Entering the field in the mid-1990s, many of us were first intrigued by the theory of sociobiology and the debates within the field about how much behaviour we could attribute to underlying strategies to maximise reproductive success. Indeed, the heated conversations around infanticide stimulated by the work of Sarah Hrdy (Hrdy et al., 1994) and the late Robert Sussman (Sussman et al., 1994) are some of our first memories of primatological theory. This was then followed by the emergence, and dominance, of the socioecological paradigm, following the publication of the pivotal 1997 paper ‘The evolution of female social relationships in nonhuman primates’ by Sterck and colleagues (1997) that incorporated the early work of Wrangham (1979; 1980). This theory not only posed interesting questions about how environmental factors, including the distribution and quality of food, influenced the way females and males behaved, but gave testable predictions derived from proposed hypotheses. This stimulated many of us to begin to answer questions such as, how do animals decide what to eat or who to interact with, or when and with whom to reproduce? However, it quickly became apparent that even these well borne out theories could not completely account for the range of intraspecific, population-level variability we were seeing in wild primate studies. Indeed, this may be because many of the ecological systems that we were initially intrigued by have been forever altered by anthropogenic impacts, highlighting the dynamic nature of these ecosystems and the importance of understanding the bigger picture of what this dynamism means for a given species and their ability to survive rapid environmental change.

These realisations have changed the primary research aims of many primatologists, requiring us to shift our priorities in an attempt to ensure that the species we are so fascinated by are not lost and are maintained for future generations to study, perhaps using the initial theories of behavioural ecology that drove us to the field some two decades ago. Not only that, but many of us have also shifted our methodological approaches and the ways we devise and seek answers to questions. In recognition of the dynamic nature of primate ecosystems and the entangled nature of the relationship between humans and our primate relatives, we are focusing on long-term, viable strategies that protect both human and animal welfare. Most recently, this has been personified in the proliferation of studies in the field of ethnoprimateology. Ethnoprimateology explicitly engages with the cultural and ecological lives of humans as important components of the broader social and ecological environment in which primates are studied (Dore et al., 2017; Fuentes, 2012; Fuentes & Wolfe,

2002; Malone et al., 2014). Theoretical and methodological developments now arm ethnoprimateologists in more holistic investigations of the human–non-human primate interface, and facilitate (or indeed oblige) the application of these insights into conservation practice (Fuentes et al., 2016; 2017). While, traditionally, primate studies were done under the assumption that primates are in ‘pristine’ settings where ‘natural’ behavioural phenomena are observed and interpreted through the lens of evolutionary models, we now acknowledge that primate social systems are subject to the influences of past and present anthropogenic alterations. Recent studies have thus documented the development of behavioural and ecological strategies in response to human activities. Rather than focusing just on the primate of interest, we are being forced to think outside the box about problems and solutions by working in multidisciplinary teams that take every part of the picture into consideration. This has been a ground-breaking development that has certainly shaped the way we think about our study subjects and the way we go about protecting them (see Chapters 3, 4 and 12 for case studies).

Such views have also changed the way many of us teach the next generation. In Australia, the first on-campus course dedicated to primate conservation began at the Australian National University in 2014, which followed on from the creation of a primate conservation field school in Cambodia in 2012. These courses trailed behind other primate conservation courses offered across the globe, including those in Canada at the University of Calgary, McGill University, and the University of Toronto. In the United States, courses with primate conservation in the title are offered at institutions such as the University of Notre Dame, Central Washington University, Columbia University, Duke University, Kent State University, the University of California at Davis, the University of Oregon, Barnard College and Colorado College. In addition, at least three universities in the United Kingdom have created entire Masters programmes devoted to the conservation of primates. The first such programme was started in 2000 at Oxford Brookes with the Master of Science in Primate Conservation. Since then, the University of Roehampton has created a Master in Primate Biology, Behaviour and Conservation and the University of Kent has begun a Master of Science in Conservation and Primate Behaviour. Researchers have thus also changed some of their education targets, recognising that the new generation of primatologists need to be exposed to conservation issues much earlier in their careers in order to provide them with the required tools to cope with the challenges facing them in the discipline. It is now the goal of many educators, the editors of this book included, to work with these budding conservation primatologists to come up with out-of-the-box, interdisciplinary solutions for the long-term threats facing our study subjects.

This sort of training has not remained exclusive to our home countries, with many primatologists also investing in education and infrastructure for people living around field research sites as a way to promote conservation and build capacity at a local level. For example, Chapter 3 of this volume outlines the successful engagement of local community members into the Sanje Mangabey Project as a way to increase local knowledge about the animals and the forest and to reduce tensions between

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local people and national park authorities. David Fernández and his colleagues have also established an education programme with local schools. For some of us, the capacity building of locals near our field sites happens at a smaller scale, with the training of a small number of research students. One editor of this volume (AB) has been involved in the co-supervision of Masters students working in Cambodia and Vietnam. Another (NM) has worked extensively with students and activists in Indonesia to facilitate ecological monitoring and conservation action. Volume contributor Jessica Rothman (Chapter 11) has also supervised Masters and doctoral students through her honorary appointment at Makerere University in Uganda. This engagement with local communities is proving very effective, which makes sense given that conservation will not work without involving those who live in the region (Muhumuza & Balkwill 2013). Research done by Riley and Zak (2015) on the impact of small primate conservation grants found that over 80 per cent of projects included listed capacity building at the individual or community level as one of their outputs, highlighting that this is becoming central to all our research questions. They also reported that grantees felt that one key to long-term conservation success is the successful collaboration with local governments and non-governmental organisations (NGOs).

The importance of collaboration with a variety of disciplines and organisations, as well as the need to engage national and international awareness through working with or establishing their own NGOs, is being recognised by many primatologists. As outlined in Chapter 9, Ed Louis established the Madagascar Biodiversity Partnership (MBP), which focuses on community-based education and research with a primary focus on the reforestation of land, including the development of nurseries to grow trees and a conservation credit rewards programme that encourages local people to participate in reforestation. While not all of us have formed our own NGOs, many of us work together with organisations such as Conservation International and Fauna & Flora International. These collaborations have proved critical for our own research, as science alone is not going to increase primate numbers and safeguard vulnerable habitats. Instead, we can use our scientific findings to inform the creation of species-specific conservation plans that are based in species biology and ecology.

A quick perusal of some of the recent scientific programmes of primatology conferences confirms this shift in the discipline. For example, when looking at the programme from the 2016 joint meeting of the American Society of Primatologists and the International Primatological Society in Chicago, Illinois, one is presented with multiple sessions in which conservation is the theme. In addition, organised symposia are becoming more often about conservation and the different challenges and approaches we face and use in the field. The editors of this book organised their own symposia around the theme of this book, which was in the esteemed company of specially organised conservation symposia including: regional conservation issues in Africa and China, issues surrounding the illegal pet trade, disease and health of non-human primates and reintroduction and translocation, as well as two that focused on working at the nexus of human and non-human primate interaction, focusing on health issues and cross-disciplinary approaches. While conservation sessions have

been occurring for many years at these congresses, our feeling is that the number focused on how we can protect our primate research subjects is quickly growing as more and more people focus their efforts in that domain.

It is the goal of this edited volume to expand on these themes both by sharing some of the conservation-focused research that is taking hold of our discipline, and also by explaining this shift in research priority through the stories and experiences of early- to mid-career primatologists. By sharing their challenges and successes as primatologists in the Anthropocene, we hope to inspire and help unify others working in similar areas and to highlight that there is no one way or one path to becoming a conservation primatologist.

1.1 The Anthropocene

Given the intensity and scope of humankind's impact and influence on ecological processes (Crutzen & Stoermer, 2000; Ellis, 2015; Steffen et al., 2011), contemporary primate research and conservation activities take place amid, and in response to, the dynamic forces of the 'Anthropocene'. The Anthropocene is a proposed formal unit of geological time whereby humankind's 'signature' of alterations to basic biogeochemical processes is written into the earth's strata. Scholars in a variety of disciplines have been quick to promote the ascendancy of the term. In contrast, the sanctioning body concerned with making the Anthropocene an official geological epoch, namely the Subcommission of Quaternary Stratigraphy operating within the overall structure of the International Commission on Stratigraphy, is content to move at 'geological speed' in an effort to identify suitable 'golden spikes', or Global Boundary Stratotype Sections and Points (J. McNeil, personal communication). Regardless of 'if and/or when' the demarcation between the Holocene and the Anthropocene is made official, and where the temporal boundary lies (i.e. prior to, at the onset of or more recently than the Industrial Revolution in Europe at c.1800 CE), the widespread adoption of the term by researchers in the biological and social sciences, as well as by philosophers and ethicists, speaks to the acceptance and analytical strength of the designation.

Conceptualising the relationships between humans and other ecosystem components, including the mutual shaping of evolutionary processes, is facilitated by embracing the Anthropocene. Humans are entangled within webs of both biotic and abiotic processes resulting in the construction of anthropogenic biomes, or *anthromes* (Fuentes & Baynes-Rock, 2017). Therefore, engaging in a primatological practice that perceives humans and other primates as co-resident in ecological and social landscapes is arguably a more efficacious approach to primate research and conservation than pretending that our study subjects are unaffected by current anthropological changes (Malone et al., 2014). For example, ethnoprimate research, along with human-animal studies and multispecies ethnography, aims to equally emphasise ecological aspects of the focal species' space and cultural elements of these shared, multispecies places (Dore et al., 2017; Malone & Ovenden, 2017). Arguably, acknowledging humankind's near-ubiquitous impact on the environment

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may serve as a prerequisite for our active management of diverse, species-rich habitats (rather than attempts to protect unspoiled, ‘natural’ wilderness). However, others argue that the terminology of the Anthropocene presents both practical and ideological complications, as well as political implications (Caro et al., 2012; Sayre, 2012). For example, Caro and colleagues (2012) point to four potential negative consequences of thinking that *humans have altered everything*, including: (1) increasing our tolerance for highly manipulative rewilding campaigns; (2) deprioritising initiatives to protect nearly intact ecosystems; (3) an enhanced ability for governments to further land use projects if habitats are already viewed as degraded; and (4) risking the spread of public pessimism and loss of monetary support for conservation agendas if the whole of nature is perceived to be altered by humans.

As evidenced by our chosen title for this volume, we see the utility of placing our present research and conservation work within the conceptual and material framework of the Anthropocene. While we acknowledge the aforementioned debates, we are convinced that an approach that engages directly with the impact of humans on primate populations is essential, especially with respect to habitat alteration, climate change, and the complexity of human–non-human primate interactions and interdependency. Increasingly, behavioural and ecological studies of primates that fail to account for these dynamics risk scientific invalidity and conservation irrelevance. Indeed, all of the contributions in this volume highlight the convergence of research and conservation agendas brought about by the impending extinction crisis within the Order Primates (Estrada et al., 2017). We remain hopeful that today’s primatologists, trained in behavioural ecology and conservation biology, and motivated by a passion for biodiversity, can meet the challenges of the coming decades.

1.2 Summary of the Book

We have organised the chapters in this book into three sections. The first, ‘The Human–Nonhuman Primate Interface’, highlights the complexity of research in the Anthropocene and the difficulty of monitoring and maintaining small populations. The second section contains chapters that address what has, for many years, been the most threatening issue facing primate populations, namely habitat alteration and fragmentation. The final section of the book addresses an emerging threat to primates that many researchers are still struggling to assess, the impact of climate change.

1.3 The Human–Non-human Primate Interface

Many research papers in primate conservation focus on the impact of single threats, or a synergistic set of threats, to primate populations. In contrast, the chapters in this section are unique in that they give historical information on the status of the study species, and holistic, detailed data on the current set of challenges that face these small populations, ending with a discussion of the conservation strategies that are being applied at these study sites. This section was initially going to focus on the threat of hunting to primates. Indeed, increases in hunting are a major issue for

primate populations globally and are the result of an ever-increasing human population, driving the demand for primates to unsustainable levels. For instance, approximately 4.9 million tonnes of bushmeat is consumed annually in the Congo Basin, and demand continues to increase despite waning supplies (Fa et al., 2002). While some of this consumption is undoubtedly for subsistence of local people, the bushmeat industry has become largely commercialised in West and Central Africa (Fa & Brown, 2009). For large-bodied primates with slow life-history patterns, levels of hunting for bushmeat are beyond sustainability and are driving species to local extinction (Cronin et al., 2016; Linder & Oates, 2011). In other regions, like Asia, demand for traditional medicine or for the international pet trade is driving up hunting pressure (Nadler et al., 2007; Nekaris et al., 2010; Starr et al., 2010). Though hunting is one reason why the primate populations discussed in this section are small, the chapters detailed here show, rightly, how complicated and unique each situation is.

In Chapter 2, Nicholas Malone and Made Wedana Adi Putra show that hunting for the illegal pet trade is a serious issue leading to the decline of silvery gibbon populations in West Java, Indonesia, and that small remaining populations struggle for viability and coexistence with the ever-growing human population. Their field site, Cagar Alam Leuweung Sancang (CALs), is an important spiritual site for Sundanese pilgrims, which leads to high human presence in the forest and increasing forms of disturbance. Yet, despite the spiritual importance of the forest, both large-scale and small-scale timber extraction have already led to the loss of half of the forest within the reserve. In Chapter 3, David Fernández, Gráinne McCabe and Carolyn Ehardt examine the current conservation situation for the Sanje mangabey in Tanzania, showing that the remaining individuals of this species are distributed in two isolated subpopulations. The authors focus on the importance of understanding female reproductive biology and dispersal patterns in assessing the long-term viability of the population. They also highlight the ways that primatologists can work with local communities, improving the lives of those living near threatened primates, to show the importance of the animals as a long-term economic resource. In Chapter 4, Alison Wade, Nicholas Malone, Judith Littleton and Bruce Floyd document range use and nest site selection of two ape species, the Cross River gorillas and Nigeria–Cameroon chimpanzees, in an unprotected forest matrix. They also interview local people to try to understand local attitudes towards these apes and barriers to successful conservation. People in this area used to hunt both ape species but as they are now protected by the Wildlife Conservation Society (WCS), hunting pressure has decreased. This has also caused local people to believe that they can no longer legally defend themselves if they are attacked by an ape. Wade and colleagues show that the gorillas and chimpanzees occupy different areas of the forest, with gorillas being more tolerant of human disturbance than chimpanzees. This is problematic because people especially fear encounters with gorillas because they are so large, usually do not flee, and range near farm boundaries. One disconcerting fact that came out of interviews with people was the almost universal idea that the forest is an endless resource.

The final chapter of this section focuses more on hunting than the other chapters, but demonstrates that primate hunting can be sustainable in certain situations.

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In Chapter 5, Chris Shaffer, Marissa Milstein, Phillip Suse, Elisha Marawanaru and Charakura Yukuma review the extent, drivers and effects of primate hunting in South America and examine how Amazonian indigenous reserves vary in management of resources. At their study site in Guyana, primates are an important source of food for the Waiwai and the authors use models of hunting depletion that include estimates of human population growth and predicted changes in hunting methods to determine how sustainable current and future hunting will be. The case study that Shaffer and colleagues present is informative as it shows how partnerships between indigenous groups, conservation organisations and international researchers can lead to successful ecosystem-monitoring projects that ensure the long-term health of ecosystems.

1.4 Habitat Alteration in the Anthropocene

Habitat degradation and loss are clearly recognised as leading threats to primates. According to Estrada and colleagues (2017), 76 per cent of primates are threatened with habitat loss due to agriculture, 60 per cent face habitat loss due to logging and 31 per cent are losing habitat for ranching and animal husbandry. This suggests that for many species, more than one form of habitat alteration is currently impacting their geographical range. According to the UN FAO (2015) report, there was a loss of 18 561 000 ha of forest cover from 1990 to 2015. In addition, from 2010 to 2015 the top ten countries with the greatest rates of forest loss are all primate-habitat countries (Brazil, Indonesia, Myanmar, Nigeria, United Republic of Tanzania, Paraguay, Zimbabwe, Democratic Republic of Congo, Argentina and Bolivia) that collectively lost 4 530 000 ha of forest cover. It is thus not surprising that investigating the impact of habitat alteration on primates has become a major focus of many primatologists. The chapters in this volume show the complex ways that primates react to habitat degradation and how certain species can adapt and tolerate some disturbance in the short term but may still be affected detrimentally in the long term through loss of recruitment or increased disease risk. The persistence of primate populations in fragmented and degraded landscapes requires tested conservation strategies and some of the authors in this section frankly discuss what has worked for them at their field sites.

In Chapter 6, Alvaro Gonzalez-Monge and Alison M. Behie focus on the impact of selective logging while it is in progress on the range use of Annamese silvered langurs in northeast Cambodia. At the time of their study, a decreased budget for law enforcement led to an increase in illegal logging within Veun Sai-Siem Pang National Park, which was rectified the following year, allowing for a comparison of langur behaviour in times of high and low levels of selective logging. Not surprisingly, langurs were found to use areas with higher levels of logging less, and to spend more time in the high canopy when logging was nearby or chainsaws were running for long time periods. This study demonstrates the important impact of law enforcement activities on decreasing illegal activities. In Chapter 7, Julie Teichroeb, Greg Bridgett, Amélie Corriveau and Dennis Twinomugisha focus on a site where selective

logging was brief and stopped by the local community, examining the responses of Rwenzori Angolan colobus immediately after the loggers left the forest. While the monkeys fled active logging areas, they did return to their former range after logging ceased. However, the study population showed all of the hypothesised changes in behaviour post-logging compared to pre-logging data. Despite the relatively small amount of damage that was done, post-logging the colobus spent less time feeding, more time resting and in social behaviours, with less frugivory and more folivory, suggesting that there could be longer-term changes in their population as a result of logging.

When animal communities are impacted by human activities and disturbance, habitats become fragmented, and biodiversity declines. This can usher in many changes that impact the abilities of the remaining animals to persist in altered habitats. Liesbeth Frias and Andrew MacIntosh, in Chapter 8, examine the relationship between host threat status and parasite prevalence and species richness, updating the classic study on these patterns by Altizer et al. (2007). The threat of infectious disease on endangered animals could either increase, as potential hosts are lost from ecosystems and pathogens are left with only the remaining animals to infect, or decrease as fewer hosts lead to the extinction of parasite species, especially host-specific parasites. Previous research supported the latter conclusion (Altizer et al., 2007) and Frias and MacIntosh used an additional ten years of data and an expanded dataset to show that though the results of Altizer et al. (2007) still hold true, the picture is complicated. Specialist parasites were found to be declining in threatened hosts but generalist parasites were actually more prevalent, perhaps finding more opportunities for niches not occupied by lost specialist species.

In Chapter 9, Sheila Holmes, Ed Louis and Steig Johnson provide valuable information on the lessons that they have learned while setting up a conservation NGO and research station in a highly fragmented area of Madagascar. They show that success in conservation practice requires effective communication between researchers and conservation managers and that the interests of multiple parties need to be considered in any conservation action. It thus pays to consult with local communities, NGOs and other stakeholders before conservation projects begin and to continue to work with them in the long term to allow success. Holmes and colleagues lay out several strategies that they have used to encourage reforestation, including participatory conservation and mixed-species planting, that take into account the needs of both people and wildlife. The authors also provide a comprehensive discussion of some of the challenges that they have faced in setting up a conservation programme, hoping to help others avoid making the same mistakes and duplicating useless efforts. In the final chapter in this section (Chapter 10), Stanislav Lhota, John Sha, Henry Bernard and Ikki Matsuda discuss the current conservation status of proboscis monkeys throughout their range. The remaining populations of this species are in scattered, fragmented areas and are often genetically isolated from one another. The authors use their years of experience in the area to lay out the most effective conservation strategies that could be used to stop declines in proboscis monkey populations and enhance connectedness between some areas.

1.5 Climate Change in the Anthropocene

Climate change is an important emerging threat to primates. While recent studies have shown some impacts of climate change on primate habitats and populations, this concept is more difficult to quantify as impacts are less tangible than those seen from habitat loss and hunting, and examining the effects of climate change often requires long-term datasets. Researchers are, however, finding more and more ways to measure the impact of climate change on their study populations. For instance, Rothman and colleagues (2015) were able to reanalyse the nutritional chemistry of ten plant species from Kibale National Park, Uganda after three decades (original data collected 1976–82 and 1994–6, and follow up in 2007–10), which showed declines in protein values and increases in fibre values, and thus concrete evidence of how climate change may threaten primate survival through the degradation of the food supply. Given the importance of the overall protein–fibre ratio of available leaves for maintaining colobine biomass, colobine populations may be expected to decrease by up to 31 per cent as a result of the changes in their food sources (Rothman et al., 2015). There has also been an increase in recent years of the numbers of studies that investigate the impacts of natural disasters on primate populations, and the increase in both the frequency and intensity of storms is at least partly due to changing climates. Our volume touches on several climate change phenomena, including changes in the resource base for primates, and the impact of natural disasters.

In Chapter 11, Jessica Rothman and Margaret Bryer review research showing that climate change can affect the distribution, availability and nutritional composition of food trees, with largely unknown impacts on primate populations. Rothman and Bryer also demonstrate how anthropogenic changes to primate habitats can affect the nutritional landscape, with loss of food due to fragmentation, the introduction of exotic species, the use of pesticides and toxins, as well as the use of crops as food. Chapters 12 and 13 focus on how the changing frequency and intensity of natural disasters are impacting primate populations. In Chapter 12, Rebecca Lewis and Anne Axel examine the effects of a damaging category-3 cyclone on the Verreaux's sifaka population at Kirindy Mitea National Park, on the western edge of Madagascar. Though no difference in sifaka body mass and reproduction was detected several months after the storm (Lewis & Rakotondranaivo, 2011), Lewis and Axel show with long-term demographic data and monitoring of food availability that the resources available in the year prior to conception had a strong impact on female ability to produce an offspring and on infant survival. Thus, the negative effects of the cyclone on infant recruitment in the sifakas was not seen until three years after the storm, highlighting the importance of long-term data in determining primate resilience, or not, to frequent natural disasters. In Chapter 13, Alison M. Behie, Mary Pavelka, Kayla Hartwell, Jane Champion and Hugh Notman compare the responses of two primate species in Belize – black howler monkeys and Yucatan spider monkeys – to hurricanes. After Hurricane Iris, a category-4 storm, hit Monkey River, black howler monkeys suffered high mortality and low infant recruitment for several years. However, spider monkeys impacted by the category-2 Hurricane Richard at Runaway