

Primate conservation

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Conservation as a “crisis discipline”

Conservation as a term merely implies ensuring that a resource, of any kind, persists and is protected from undue loss. However, conservation as an ecological discipline often calls to mind dire circumstances, ranging from massive habitat loss to species on the brink of extinction. Indeed, the field of conservation biology can often be characterized in practice as a “crisis discipline” (Soulé 1985), one that must respond readily, rapidly, and persistently to threats facing biodiversity and natural landscapes. Yet for conservation aims to be maximally effective, they must meet the root causes of biodiversity crises at the source, preemptively addressing the wide-ranging threats facing wildlife and natural environments that allow crises to develop when left unchecked. In an ideal—and unrealistic—world, if conservationists were able to address biodiversity concerns both fully and consistently, conservation would not function as a “crisis discipline” at all.

Multiple and multidisciplinary strategies and tools are employed as conservation tactics to address wide-ranging biodiversity challenges head-on, and primate conservation’s priorities and purpose fit well within the strategies and framing of the field of conservation as a whole. Indeed, successful primate conservation efforts cannot be limited to the conservation of a single primate population, species, or even the Order Primates alone. Instead, primate conservation, aptly practiced, views primate species within a larger ecological and often human-influenced landscape and thus their conservation as a cross-disciplinary and holistic process. Nevertheless, the close connection humankind shares with

primates, as our closest living relatives, engenders in some a special urgency toward the protection of our biological cousins. Primate entanglement with some of the most-pressing global threats facing biodiversity as a whole additionally draws international attention to the plight of primate species. Primates thus serve as important models for conservation, representing species largely advocated for by the conservation public and in need of express conservation action.

Primate conservation classification schemes

Primate threat status: the IUCN Red List

The International Union for the Conservation of Nature and Natural Resources (IUCN) was founded in 1948 as an international conservation organization that has since grown to become one of the most influential conservation bodies in the world. Indeed, its Red List of Threatened Species, which uses precise criteria to establish extinction risk, serves as the most definitive conservation status ranking system for living organisms. For primates, the IUCN/SSC Primate Specialist Group (PSG) collaborates to determine Red List rankings for primate species, placing each of the list’s over 400 assessed species into the following Red List categories: Extinct (EX), Extinct in the wild (EW), Critically Endangered (CR), Endangered (EN), Vulnerable (VU), Near Threatened (NT), Least Concern (LC), Data Deficient (DD), and Not Evaluated (NE). By common practice, species deemed “threatened” by extinction are those that encompass the Critically Endangered, Endangered, and Vulnerable Red List categories.

A summary of IUCN Red List threat status for the Order Primates reveals the urgency with which primate species may be viewed as a conservation concern (Table 1). Globally, over half of all evaluated primate species are considered threatened (compared to one-quarter of all listed mammals: IUCN 2016), with Madagascar peaking as the primate range area (of Africa, Madagascar, Asia, and the Neotropics) with the

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Table 1 Percentage of primate species threatened and number of extant primate species per represented IUCN Red List threat category across Africa (excluding Madagascar), Madagascar, Asia, and the Neotropics. Note that Europe, which contains only one naturally occurring primate species (Barbary macaque, *Macaca sylvanus*, Endangered), has not been included in this table.

<i>IUCN Red List Threat Status</i>	<i>Total</i>	<i>Africa</i>	<i>Madagascar</i>	<i>Asia</i>	<i>Neotropics</i>
% Threatened	61	36	91	76	44
Critically Endangered (CR)	59	6	22	16	15
Endangered (EN)	114	11	48	36	19
Vulnerable (VU)	82	14	20	25	23
Near Threatened (NT)	22	4	3	9	6
Least Concern (LC)	119	47	3	11	58
Data Deficient (DD)	19	2	3	4	10
Total number of species	417	86	99	101	131

highest percentage of threatened species (over 90%: IUCN 2016). Beginning in 2000, a biennial list produced jointly by the International Primatological Society (IPS), PSG, Conservation International, and the Bristol Zoological Society entitled “Primates in Peril: The World’s 25 Most Endangered Primates” (Schwitzer et al. 2015) draws experts together to name and highlight species in severe danger of extinction, while emphasizing threats faced by primates across the globe. While the list often retains certain species for multiple years, like the Cross River gorilla (*Gorilla gorilla diehli*), to emphasize their continuing plight, others, such as the golden lion tamarin (*Leontopithecus rosalia*), have been removed due to promising conservation efforts.

The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), ratified in 1975, classifies species involved in international trade into three appendices according to their threat status: Appendix I prohibits trade of listed species, threatened with extinction, in all but the most infrequent scenarios; Appendix II allows for controlled trade of species in order to avoid overexploitation; and Appendix III includes species protected by at least one CITES Party country requesting assistance in trade control. All primate species currently listed by CITES, well represented by primate-range countries, are protected under Appendices I and II, indicating a degree of formal international support for and cooperation surrounding primate persistence.

While extinction is an all-too-omnipresent possibility for many primate species, the first

extinctions of primates in the present era may have already begun. The IUCN Red List classifies two primate species as extinct: *Xenothrix mcgregori*, of Jamaica, and *Palaeopropithecus ingens*, of Madagascar, both of which may have disappeared as recently as the last 500 years. Oates et al. (2000) noted the probable extinction of Miss Waldron’s red colobus (*Procolobus badius waldroni*) as suggestive of an ongoing extinction spasm of other species in West Africa. While the current IUCN status of *P. b. waldroni* is Critically Endangered, no direct sighting of Miss Waldron’s red colobus has been confirmed since 1978. Primate extinctions can, and likely will, happen within present human generations, especially as numerous populations of imperiled primate species number only in the hundreds of individuals.

Primate threats

A range of interlocking and interminable anthropogenic forces threaten the survival of primate species and prompt warranted concern for primate conservation. Direct threats to primate populations broadly range from habitat loss to bushmeat (see BUSHMEAT) and live animal trade, disease, human population growth, and infrastructure expansion, as well as climate change-induced fires and weather events and loss due to pest control. Other, indirect impacts are equally potent: difficulty in making and keeping robust international agreements, unstable political situations in primate-range countries,

corruption across all levels of leadership, ineffective top-down management schemes, and other logistical challenges and realities of conservation efforts in situ can often mean that even the best-laid plans are laid to waste. As no primate species is limited to the influence of only one of these threats, initiating any effective conservation action necessitates using a wide lens to capture and address the full and complicated picture.

Habitat loss and fragmentation

Of special concern is the impact of habitat loss due to its role in inviting a range of cascading after-effects (see *DEFORESTATION* and *CLIMATE CHANGE AND PRIMATE CONSERVATION*). Non-human primates, predominantly found in the Tropics and overwhelmingly utilizing forested environments (over 90% of listed species: IUCN 2016), are unfortunately in the evolutionarily right place in the ecologically wrong time. Janzen categorized the Tropics' remaining forests, ravaged even then by immense human deforestation, as "hardly more than scattered biotic debris" (Janzen 1988, 243), remnants incidentally and tenuously remaining despite human landscape use. A global examination of Landsat data between 2000 and 2012 revealed a loss of 2.3 million square kilometers of forest during the study period (Hansen et al. 2013), staggering as global area—including ocean space—is only between 20 and 25 times that amount. For primates in particular, less than 10 percent of African great ape habitat and 1 percent of orangutan range is projected to remain undisturbed by human influence by 2030 (Nelleman and Newton 2002).

The logging and mining industries, richly represented across primate-range countries, facilitate human exploitation of previously underutilized tracts of forest through infrastructure expansion (e.g., road building), enabling increase in primate hunting pressures and population decline. Further extractive activities, like gold mining, can additionally impact the security of resident primate populations. Conservationists and primatologists alike increasingly recommend collaboration with commercial endeavors to monitor and influence a project's ecological impact.

Even without large-scale habitat alterations like those found within logging concessions, fragmentation caused by the shrinking of primate habitat further affects primates across a range of ecological and biological factors, from distribution to diet, behavior, and physiological stress. Fragmentation as a process introduces additional anthropogenic effects (e.g., hunting, invasive species), modifies habitat quality and characteristics (e.g., via edge effects and habitat isolation), and restricts ranging and dispersal abilities for primates, affecting genetic diversity. With the ever-increasing presence of fragmented landscapes, it is no longer feasible to predominantly situate primate conservation and behavioral research studies within an "unaltered," or "natural," habitat.

Addressing the Anthropocene

Of course, primates are not the only nonhuman species adjusting to an overwhelming increase in human-dominated habitats: scholars across disciplines ranging from the social to biological sciences are heralding the current age of the Anthropocene, a geological age (not unanimously agreed upon as) overtaking the Holocene as a global period characterized by humankind's dominant influence on both climate and the environment (see *ANTHROPOGENIC LANDSCAPES*). Just as the threats facing primate species are largely human-driven, so too, then, is the very environment that primate species experience.

The rising field of ethnoprimateology (see *ETHNOPRIMATEOLOGY*) additionally addresses primate issues in the Anthropocene by studying human and nonhuman primate interactions, merging both primatological and cultural anthropological perspectives to understand human influence on primate behavior and human perception of primates. The marriage of this field with conservation efforts thus yields important insights into the sociocultural drivers of primate conservation concerns.

Ethnoprimateological approaches additionally recognize that primates are adapting to the Anthropocene just as readily as humankind is expanding its global influence. Chimpanzees have been reported to adeptly deactivate snares

(Ohashi and Matsuzawa 2011), while a baboon troop was documented as transitioning into crop-raiders over a period of two years, doubling their intake of human foods (58% of total diet: Strum 2010). Clearly, if the threats facing primates are of human origin and if primates themselves are adapting to their often-forced incorporation into human landscapes, the human dimension of conservation is vastly important; it is therefore paramount to approach conservation with knowledge of both biological and social processes in hand.

Hotspots and protected land in primate-range countries

Conserving primate species necessitates conserving the land essential for their current survival and future perpetuation. Historical approaches to conservation of species have utilized this protectionist approach by largely focusing on protected areas. Yellowstone, born of the American Wilderness Movement in 1872 as the world's first national park, spurred a conservation surge intent on preserving "wild" landscapes, saved from human exploitation and common use predominantly for the fulfillment and enjoyment humankind could find in "untouched" nature; national parks across the globe—and in primate-range countries, like South Africa's Kruger National Park—followed suit. Today, the most recent list of global protected areas, as compiled by the United Nations Environment Programme World Conservation Monitoring Centre (UNEP-WCMC), recognizes 209,429 sites, covering nearly 33 million square kilometers.

While protected area designations, of truly protected and properly monitored land, surely help to conserve the populations of primates that live within park boundaries, limited resources for conservation work necessitate prioritization of certain landscapes—and zones of biodiversity—over others. One of the most popular means of establishing geographic conservation priorities is through biodiversity hotspots. Today, biodiversity hotspots are the 25 most-biodiversity-rich localities in the world that represent the greatest range of endemic diversity, many within primate ranges. The hotspot

approach recognizes the all-too-ubiquitous reality that conservationists cannot protect everything: by prioritizing zones of especial conservation concern, hotspots allow conservationists to make the most of available resources, at least in terms of protecting the greatest number of endemic species. This strategy has, quite literally, paid off. As of 2003, hotspot approaches have together received US \$750 million, the largest amount ever given to any one conservation strategy (Myers 2003).

Through the ecosystem services hotspots provide, protection of these zones is also directly beneficial for humans: 56 percent of ecosystem services (e.g., oxygen production) are produced in high-biodiversity and thus high-conservation-priority areas (Turner et al. 2012). Note that primate conservation contributes directly to facilitating ecosystem services: loss of seed-dispersing primates signals a loss of forest growth and productivity (Redford 1992) and can even weaken the genetic structure of plant communities (Pacheco and Simonetti 2000). It is important to advocate for the protection of particular primate hotspots as well, as areas of high primate biodiversity may not be represented in more general schemes (Meijaard and Nijman 2003).

Beyond park boundaries

Conservation plans cannot rely solely on the protection these designated zones provide. Protected areas and parks are far from immune from the threats facing nonhuman primates, as logging, bushmeat hunting, and disease outbreaks ravage primate populations in and outside of park borders. Support for "fortress conservation" began to wane globally in the 1990s as the need for more widespread protection of biodiversity caught up with the ethical challenges of often displacing, or at least disrupting, the local human populations that had previously relied on the protected areas for their livelihoods. Protected area management is also a human process and thus one susceptible to shifting political structures, mismanagement, corruption, and the concept of the "paper park," a protected area that hardly exists in the functional sense, only protecting wildlife through false, written promises. While preserving intact

ecological communities is ideal for pure conservation purposes, the purely protected area approach is now recognized as outmoded: in primate conservation, human communities must be recognized and incorporated into the process just as readily as nonhuman primate communities are protected.

Corridors, buffer zones, and human-modified environments

Considering the importance of habitat connectivity and the existence of vulnerable primate populations within larger potentially rejuvenating metapopulations, wildlife corridors are important means of linking and thus improving the impact of conservation zones. In a study of wildlife corridors mixed with industrial plantations in Indonesia, Nasi et al. (2008) confidently and “unambiguously” assert the importance of forest corridors to primate populations, while numerous other reports similarly demonstrate corridor value to primate species across the globe. A large-scale assessment of the Ambositra-Vondrozo Corridor (COFAV) linking Ranomafana and Andringitra National Parks in southeastern Madagascar (Ramiadantsoa et al. 2015) reveals the value of careful evaluation of corridor effectiveness and governance to ensure that the landscapes are properly accessible to wildlife and that any corridors in danger of being lost to deforestation are managed before they become ineffective. As with any conservation strategy, wildlife corridors are an imperfect, although useful, approach, liable to transport disease as much as endangered species and to engender complicated questions of politics and efficacy. Yet, in corridors’ abilities to link viable primate populations across commonly considered “lost,” heavily human cultivated lands—ranging from private holdings to plantations and even across urban environments—wildlife corridors serve to bring individual conservation efforts into the larger picture of primate conservation.

The establishment of buffer zones (e.g., IUCN Protected Area categories V and VI) around protected areas additionally allows both primate and human communities to transition along a

gradient of human disturbance and landscape use. Buffer zones allow the needs of local human populations to be addressed, while simultaneously enforcing restrictions on total resource use, thus protecting species from overexploitation. As these land designations take a variety of forms, they may be adapted easily to reflect the size and ecological requirements needed for relevant species of interest and may be designed to meet the appropriate economic and social needs of local communities. Buffer zones are important inclusions in national park planning and can help mediate human–wildlife conflicts, such as crop-raiding.

Since 2007, the United Nations Programme on Reducing Emissions from Deforestation and Forest Degradation (UN-REDD) supports national REDD+ programs to financially reward 64 partner developing countries, many of which lie within primate ranges, that engage in the following activities: (1) reducing emissions from deforestation and (2) forest degradation; (3) conservation and (4) enhancement of forest carbon stocks; and (5) sustainable management of forests. For once, the coincidence of primate ranges with areas of heavy tropical deforestation may be resulting in increased investment in primate forest protection through carbon offsetting schemes.

Conservation of more than natural landscapes

As popular and well-populated primate sites like the Barbary macaque stronghold of Gibraltar, Spain and the Sacred Monkey Forest Sanctuary in Ubud, Bali demonstrate, primates are not limited to pristine forests and environments untouched by man. Indeed, and more importantly, primates occupy a range of human-dominated landscapes beyond these dedicated tourist sites. There is a bias, however, among conservationists and the general public alike, toward protecting “natural” land, preferable over spoiled, human-dominated landscapes. This dichotomy, between perfect-nature and human-land, is unfair and damaging to conservation efforts for two primary reasons: (1) it prioritizes a type of landscape that is rapidly being replaced by more human-dominated primate zones; and (2)

“natural” landscapes typically already experience the influence of local human populations, who become marginalized in favor of conservation efforts inconvenienced by their presence (Gomez-Pompa and Kaus 1992).

As Alcorn notes, “conservationists interested in achieving on-the-ground conservation of biodiversity have to choose among real options, not idealized academic ones” (1993, 424); all of the lands primates currently occupy are potential, real, options for conservation, not just the idealized “natural” landscapes that seem to be perfect for primate well-being. Overall, opportunities abound for primate conservation across primate ranges, especially in human-modified habitats and zones.

Foundational approaches to species preservation

The fields of conservation and of conservation biology are difficult to define, precisely because they necessitate being adaptable to the changing climates of global conservation priorities. Effective conservation practitioners are expected to be scientists, educators, managers, policy makers, and advocates, attuned to sociocultural subtleties, and aware of both global and local economic and political milieus. Soulé (1985) provides a good introduction to approaching the underpinning principles of conservation biology—albeit a slightly outdated one in its focus solely on species and environments with no reference to human populations. The piece importantly highlights the philosophical moral and ethical beliefs intrinsic to a conservation mindset: in order to justify the complicated processes associated with protecting primate species, primate species diversity—and the existence of any primate species in the first place—must be intrinsically good. After all, the world can exist without nonhuman primates (just as it has been demonstrated to thrive without human inhabitants). What, then, justifies their protection?

Rolston, like Soulé, asserts that humanity has a duty to endangered species, arguing against human tendency to value itself above and beyond all other forms of life: “there is something [. . .] morally naïve,” Rolston says in reference to this

common human perspective, “about living in a reference frame where one species takes itself as absolute and values everything else relative to its utility” (1985, 726). Furthermore, asking whether guenons or gorillas, lorises or lemurs should exist is merely “a single increment in the collective question, ‘Ought life on Earth to exist?’” (Rolston 1985, 723), a question many, if not most, humans would answer in the affirmative.

Integrated conservation development programs

While moral ideas, such as the ones above, are integral background for primate conservation project aims, they should by no means be even subconsciously used to prioritize primate needs over those of human populations. Broad current and historical camps of conservation thought split conservation practitioners into two categories: nature preservationists, interested in protecting natural communities, and social conservationists, believing in the partnering of conservation aims with social issues. The concept of integrated conservation and development programs or projects (ICDPs) began as a solution to, in inappropriate terms for conservation, kill two birds with one stone. In addressing both conservation and social concerns in one conservation-and-development project, advocates believed that both the causes and results of human-initiated threats to species could be curtailed, while benefiting local human populations through employment opportunities, infrastructure expansion, training and education, or any combination of these and other means.

ICDPs centered around the conservation of primate species have been implemented with success, notably with the Community Baboon Sanctuary (CBS), working with black howler monkeys (*Alouatta nigra*) in Belize (Horwich and Lyon 1998), and Proyecto Títi, focusing on cotton-top tamarins (*Saguinus oedipus*) in Colombia (Savage et al. 2010). As examples of just some of their efforts, Proyecto Títi has trained local residents in the art and business of creating Eco-Mochilas, income-generating, environmentally friendly purses and bags (Savage et al. 2010), while CBS pairs voluntary involvement of local

landowners in corridor preservation with ecotourism (see ECOTOURISM) efforts (Horwich and Lyon 1998).

In other, and many, instances, however, ICDPs fall short of expectations and have been widely criticized for poorly approaching both conservation and development goals rather than focusing on one realm in particular: ICDPs cannot, as many try to, “do it all.” McShane et al. (2011) highlight the dangers of the “win-win” ideology espoused by ICDPs and frequently shared with donors and project participants; framing ICDPs as the solutions to both conservation and social challenges neglects the complicated reality of these efforts and the need for compromise in meeting joint aims, all the while setting the stage for “a vicious cycle of optimism and disenchantment” (McShane et al. 2011, 967). Of course, handling such interrelated issues as conservation and development necessitates addressing—and linking—both territories; rather than abandoning the concept of ICDPs, new and existing projects should focus on reworking aims to more clearly address the link between human and natural environment welfare goals. Strategies include considering environmental accounting of truly beneficial environmental assets or identifying jointly advancing ecosystem services that will directly benefit both human and animal populations.

Primate conservation: techniques and technologies

In one of the first concentrated global approaches to primate conservation, Russell A. Mittermeier, as Chairman of the PSG, penned the 1978 *Global Strategy for Primate Conservation* which highlighted the following strategies for protecting the survival of primate species (Mittermeier 1978):

- Creation of protected areas.
- Establishment of particularly large reserves in high-diversity or high-abundance zones.
- Upkeep of existing protected areas in primate ranges, especially with regard to law enforcement.
- Public awareness, highlighting primate conservation importance and its relevance to primate-range countries.
- Management schemes for the coexistence of primates and humans in human-influenced areas.
- Establishment of captive breeding programs for conservation purposes.

These strategies hold today, emphasizing that while techniques and technologies useful to primate conservation efforts may change, the major action points that primates need for their survival, in a conservation context, will remain largely the same over time. As the strategies employed for primate conservation vary from project to project, this outline will only be able to address the following large-scale and heavily employed approaches, loosely following the order of Mittermeier’s (1978) aims: (1) maps and models; (2) policy; (3) conservation education and (4) public outreach; (5) conflict mitigation; and (6) population management. Today, too, multiple conservation and primate organizations and resources, beyond the IUCN/SSC PSG, assist in supporting, facilitating, and even funding primate conservation research.

Maps and models

With innovations in species distribution modeling techniques as well as improvements in remote sensing capabilities, advanced mapping, and predictive modeling, conservationists are able to focus limited resources on key areas of importance and concern. Dr. Jane Goodall first acted upon the enormous threat of deforestation to her site’s chimpanzee populations in the 1980s when she was alerted to its true and terrible extent during her first flight over Gombe, roughly three decades and thus many years of potentially unchecked deforestation after her initial arrival (Pusey et al. 2007). Mapping techniques allow for primate conservationists to be warned of conservation priorities and impending sites for concern without having to physically be at the site, an enormous benefit when considering the true extent of landscapes needed to be considered for primate conservation, and mapping’s ability

to quickly and effectively impress upon relevant stakeholders, including donors, important conservation information.

Improved mapping and remote sensing technologies, including smaller, satellite-based radio collars and satellite camera traps for tracking primate species, using LandSat to estimate population sizes of large-bodied primates, the expanding use of drones in allowing for immense visual exploration of often-difficult terrain, and photo recognition of primate individuals and species, produce enormously impactful data for conservation projects, especially when paired with probabilistic models for encountering species and populations.

Powerful technology is made even more impactful when linked with a global citizen science network (e.g., through crowdsourcing camera trap data), both allowing for more rapid data processing and connecting the public to conservation efforts. Examples include *Chimp & See*, a catalogue of chimpanzee demographics and behavior via camera trap, and *Zooniverse*, an online camera trap-reading platform engaging interested volunteers in projects, like *Chimp & See*, ranging from the Serengeti to distant galaxies.

Primate conservation policy

Geographic action plans for primate species help to identify regional and taxon-specific goals and priorities for primate conservation. Indeed, over 15 action plans specific to great apes are available through the PSG (http://www.primatesg.org/action_plans/).

Such large-scale organizational efforts help to prioritize conservation efforts, acknowledge major challenges, and form a more united front against regional conservation threats, important as the path toward effective conservation efforts can often be unclear and one where researchers, referring to sustainable development and conservation, may be “seeking pieces of a mosaic of development, the overall pattern of which, like the web of biodiversity, can only be guessed at” (Holloway 1993, 92). Policy and collaborative efforts regarding conservation planning help to reduce this guesswork; after all, the severe “deadlines” conservation threats impose on primate species do not react kindly to missteps.

With the National Institute of Health (NIH) in the United States no longer supporting biomedical research with chimpanzees, facilitated in part by a 2015 decision by the US Fish and Wildlife Service to classify captive chimpanzees as endangered, the protection of, at least some, captive primate populations was firmly established as a priority. Likewise, national and international agreements and efforts have sought the protection of great apes and other primate species. The Great Apes Survival Partnership (GRASP), founded in 2001, brings together almost 100 countries, conservation organizations, and research institutes and corporations to address great ape conservation and is the “only species-specific conservation programme within the UN.” GRASP combines policies, education, and on-the-ground conservation in its approach to protection of the great apes. While achieving effective policy aims can often be difficult within corrupt or bureaucratic institutions across many primate-range countries, they are well worth pursuing in conservation planning.

Conservation education

Conservation education has been commonly touted as an irreplaceable strategy in conservation initiatives due to its ability to change the knowledge, attitudes, and behaviors (KAB) of its participants in ways that align with the needs of local, or even global, animal communities. Primate conservation education programs and initiatives in particular are no different, occurring in countries and sites across all primate ranges and appealing even to international audiences. These programs use a range of strategies and techniques to reach their aims, from the use of innovative games, parades, and lemur costumes with Conservation Fusion in Madagascar to nature clubs in Columbia (Savage et al. 2010), and may even occur seemingly informally through social media outlets.

The serious role education has to play in primate conservation efforts should not be lost behind its often light-hearted reputation, however. In hopefully encouraging long-term ameliorative attitudes of human communities toward primates, primate conservation education serves as a necessary investment in the future of

primate populations. Yet conservation education can often be “written-off” in evaluations of conservation efforts, casually believed to be beneficial no matter what, and ironically often lacking in true education expertise: conservationists and primatologists hoping to incorporate education aspects in their projects should utilize robust evaluation methods, educator training, and the insights of collaborating partners in education and development fields to ensure that their programs are maximally effective and valuable for program participants.

Connecting to a broader public: media and ecotourism

An extension in many ways to primate conservation outreach efforts, expanding media use across the globe and ecotourism (see ECOTOURISM) efforts guided toward or incorporating primates can lead to an increase in primate conservation awareness and protection. Mass media use has been recommended as an outreach method (Oates 2013), with productions such as the IMAX film *Island of Lemurs: Madagascar* and Disney-nature’s wide-release documentaries *Chimpanzee* and *Monkey Kingdom* bringing primates to the big screen—and, perhaps more importantly, to the laptops in people’s homes. Each of these efforts has created supplemental educational materials, allowing schools and other interested parties to expand upon their introduction to primate behavior and ecology as well as conservation concerns each of the films provided. Likewise, primate conservation efforts have embraced social media’s grasp on the globe by creating Facebook, Instagram, and Twitter accounts (e.g., Centre Valbio: @centrevlabio; Proyecto Titi: @proyectotiti; Primate Education Network: @primateeducationnetwork), connecting both primate-country nationals and international communities to on-the-ground conservation efforts. Cell phones have even been suggested as a strategy for citizen science in their ability to link citizens in primate-habitat countries with wildlife trade and monitoring efforts, among other uses.

Notable ecotourism efforts, like gorilla watching in Rwanda and Uganda, have connected primate enthusiasts and adventurers alike to the beauty of primate populations, building global

awareness and consciousness of the importance of protecting them, in addition to providing an infrastructure for their continued support. Ecotourism efforts link visitors to tangible conservation issues while building support through highly personal animal interactions, a confirmed means of establishing deep connections to wildlife. While caution should be and is exerted in preventing disease transfer in ecotourism contexts and in preventing unwanted consequences of introducing new human populations to primate ones, ecotourism as a conservation strategy is a valid means of both protection and outreach.

Conflict mitigation

As shrinking resources and growing human populations push primates and humans into closer contact, conflicts between primate and human interests will only continue to grow (see HUMAN-PRIMATE CONFLICT). Most notable of these is the presence of primates as crop pests, a serious issue that cannot be ignored in favor of portraying primate species in a purely positive light. Conservation efforts should assess the needs and even complaints of local populations regarding their interactions with the project’s focal species of interest in order to anticipate conflicts and address them head on. Strum (2010) advocates the use of rapid assessment tools to focus on key strategies in addressing conflicts; for crop-raiding, Strum suggests (1) assessing the history of raiding at the project site; (2) a rough benefit-to-cost ratio for the primate raiders to determine what is at “stake” for the primate populations; (3) understanding the degrees of flexibility present in foraging techniques; and (4) evaluating how to best interact with human victims of crop-raiding.

Population management

Incorporating population management—through individual relocations or translocations, introductions, captive breeding schemes, or rehabilitation efforts—has long been held as a tactic in conservation initiatives. By introducing carefully planned and novel genetic diversity into zones of primate occupation, efforts such as translocations

(moving individuals from one area to another) or introductions (bringing new populations to areas currently unoccupied by that primate species), population management can both strengthen the viability and persistence of primate metapopulations and widen a species' range (see *PRIMATE CONSERVATION GENETICS*). Population management typically involves close monitoring of primate populations coupled with projections of their future success. Population viability analysis (PVA) allows conservation biologists to model primate populations to predict their likelihood of extinction over a given time period and under varying conditions of duress. These predictions can then be used to help guide and prioritize conservation efforts.

Of course, population management efforts are not immune to controversy. PVAs themselves have been criticized for being overly relied upon, particularly when predictions can prove ineffective at dealing with small datasets and in accounting for nondemographic processes of population control, like catastrophes. Primate relocations and translocations have also been met with mixed success, pointing to the potential ethical challenges of population management as well as the need for determining whether the costs, including great financial ones, are worth the risk and payoff.

Combatting ecocolonialism

Conservation without involvement, approval, and guidance from affected local human populations is not effective conservation at all. In fact, imposing often heavily invasive conservation strategies on local communities is a form of neocolonialism termed "ecocolonialism" (Cox and Elmqvist 1997), and, as the name hopefully implies, should be avoided in conservation efforts. In addition, raising false expectations about the outcomes of conservation efforts in terms of their benefits to local populations can create reluctance for participation in future projects (Oates 2013). An appreciation and acknowledgment instead of the local voices and context inherent in all conservation challenges and opportunities in primate-range countries allows for a sustainable and more well-received—and thus more

successful—conservation effort. The International Primatological Society has also highlighted the importance of community engagement by assembling a list of 25 "Guidelines for Conservation through Community Involvement" (Reynolds and Bettinger 2008), organized according to planning, implementation, monitoring and evaluation, and funding aims.

Incorporating community involvement means not only listening to community concerns but also involving community leaders and interested local parties in conservation leadership and in project planning and implementation. Oates (2013) suggests the importance of engaging primate-range-country citizens directly with conservation work by developing training for local involvement and by reaching out to local policymakers and government personnel.

The role of research

Primatologists are well primed for valuable contributions to conservation biology in their ability to monitor primate populations and capture environmental and behavioral shifts in response to conservation concerns. An evaluative review of the long-term impact of esteemed primatologist Jane Goodall's research site at Gombe National Park, Tanzania outlined the impact of Gombe's productive research presence in raising international and local support for chimpanzees and in monitoring chimpanzee health and populations over more than half a decade of research (Pusey et al. 2007). Other research sites echo Gombe's claim that long-term researcher and project personnel presence have contributed positively to the sustainability of their wild primate research populations. Research sites have also incorporated conservation efforts into the larger picture of their work. To note only some examples, Gombe has created the Lake Tanganyika Catchment Reforestation and Education Project (TACARE), focused on local land-use plans surrounding the Gombe research site (Pusey et al. 2007); the Dja Conservation Complex, Cameroon has employed antipoaching patrol units; and Kibale National Park has developed education initiatives in addition to game guard reward systems for halting the influence of poaching. A 2012 collection of essays

on long-term primatological field sites, edited by Kappeler and Watts, highlights the contribution of long-term research to understandings of primate behavior, ecology, and conservation. While long-term research encourages the general conservation of study sites through local, invested employment, protection and monitoring of site habitats, and increased ability to report and detect illegal activities, many long-established research projects make active ongoing and wide-ranging impacts on the conservation community. One such site, Centre ValBio (CVB) in Ranomafana National Park, southeastern Madagascar, follows its foundational dual goals of conservation and research by leading and supporting numerous conservation and research endeavors; since 1991, the work of both researchers and conservationists based out of CVB has made valuable contributions to conservation, from discovering new species to understanding the influence of climate change, habitat disturbance, and predation on lemur behavioral flexibility and population density (Wright et al. 2012).

Primate research has identified the difficulties in making generalizations about conservation action across study sites, particularly in the realm of the effects of fragmented landscapes, yet multiple insights may be gained from reviewing primate conservation literature. Important research into human–primate diseases and primate parasites, including conceptualizing parasites as indicator species of primate health, has revealed guidelines for prevention of disease transmission, especially important for consideration in areas of long-term behavioral research and ecotourism. Irwin (2008) notes the importance of long-term monitoring, rather than mere census techniques, in capturing necessary and accurate information for population viability analyses of species, like primates and his study's diademed sifaka (*Propithecus diadema*), with long life histories. Furthermore, research into primates in novel and changing environments can reveal insights into how primates may utilize human introductions to their benefit, valuable in conservation planning and management. While innovative solutions to conservation problems can use information from a wide variety of primate research topics, primary valuable areas of further research include:

- Long-term monitoring of primate populations.
- Creation of range-wide primate distributions and habitat suitability maps.
- Response of primates to human-influenced habitats.
- Primate use of corridors, and protected and nonprotected areas.
- Exploration of human–nonhuman primate disease transfer and control techniques.
- Censuses and evaluation of human–primate conflicts and interactions.
- Committed evaluation of primate conservation project management and activities.
- Primate response to ecotourism with a focus on adaptive management schemes.

To return to previously mentioned research efforts, Pusey et al.'s (2007) study, however, noted that crises facing chimpanzee populations at Gombe were not discovered as quickly as they could have been due to a close focus on behavioral research for decades at the site rather than on larger objectives. Indeed, primatologists may even have an outright responsibility to aid in conservation efforts in protecting their study subjects, especially as they should be more attuned than outside observers to the conservation challenges unique to their particular site. Behavioral research, arguably the core of primatological work, is not often incorporated into conservation planning, yet it could lead to predictive wildlife models based on species behavior or to valuable insights into corridor use, response to human activities and landscape changes, or why particular species are more vulnerable than others to human presence. Caro and Sherman (2013) urge behavioral researchers to commit more fully to conservation-based research by pointing out the fully resolvable “Eighteen reasons animal behaviourists avoid involvement in conservation,” including damaging perceptions of conservation by academia as “less prestigious,” “less intellectually stimulating,” a lost cause, or outside of the realm of researchers' involvement.

Just as paper parks, in falsely portraying conservation commitment, are counter-productive—indeed, damaging—to biodiversity conservation, so too are research paper promises. While conservation should be a priority for primate

researchers when designing research, it is understandable that not all research can and needs to be conservation-centric. Therefore, research that is not applicable to conservation should importantly not be touted as such. Oates outlines the problem when speaking about primatological research: “words about ‘conservation’ often seem to be used to justify getting a grant or framing the logic of a publication, with insufficient attention given to ensuring the long-term benefits for the survival of primate populations result” (2013, 243). While primatological and other ecological publications commonly point to the conservation implications of their research, they should truly be focusing on conservation applications, tangible results of their research, carried out by either themselves or dedicated research or conservation partners.

Just as overrepresentation is dangerous to primate conservation efforts, so too is complacency. Again, Oates does not skirt the issue: when the International Society of Primatologists speaks of conservation, he says they “often seem to want to follow currently fashionable consensus views and seem to regard it as inappropriate to criticize those who say they are doing conservation” (2013, 244). In sum, if primate conservation were to fail in part due to the pride and politeness of primatological researchers, they would have done a huge disservice to the study subjects they undoubtedly hold dear.

Future directions

In a bold call to primatologists, Oates (2013) surveys what he terms the “elders” of primate conservation, including primatology notables such as Alison Jolly (see JOLLY, ALISON), Anthony Rylands, Tom Struhsaker, and Christophe Boesch, to gain insights into how the field could best progress. The group identified major needs for effective conservation as: (1) addressing major direct threats to the survival of wild primate populations; (2) identifying drivers of these threats; (3) pinpointing appropriate counteractive strategies; and (4) addressing factors that challenge these aims. Political roadblocks, including corruption and lack of political willpower, gaps in scientific knowledge, inappropriate top-down management policies, and overdiscussion of

conservation action in meetings and workshops as opposed to undertaking direct action instead were listed as potential challenges. While any one of these challenges can seem insurmountable, particularly in the face of the larger global processes challenging primate habitats and populations, the enthusiasm and passion conservationists have for their project subjects and for their work is one of conservation’s greatest assets.

Building upon current structures of conservation, by building up collaborative efforts, like GRASP, across fields and across both the public and private sector this will serve to link impassioned primate advocates across disciplines and lead to further innovations in project implementation. Further training efforts in primate conservation biology, implementation, and management are also needed to create conservation leadership and guidance in a field whose successful strategies desperately need to be made both clearer and more replicable. Graduate training programs are engaging new students interested in wild and captive primate work, nongovernmental organizations (NGOs), research settings, and social development with interdisciplinary approaches to primate conservation. Continual training for current conservation professionals should lend insights into improvements and innovations in the field as well as expanding techniques beyond traditional realms, such as training conservation practitioners in highly structured decision-making techniques. As conservation challenges are direct by-products of changing responses to the modern world, so too must primate conservation adapt to the present and anticipate the future. After all, if primates are known to be one of the most adaptable Orders in the animal kingdom, surely the field dedicated to its protection can be too.

SEE ALSO: Biological corridors; Cultural primatology; Demography in primatology; Ecological communities

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