HUMAN ATTITUDES TO PRIMATES: PERCEPTIONS OF PESTS, CONFLICT AND CONSEQUENCES FOR PRIMATE CONSERVATION

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INTRODUCTION

The human perception of nonhuman primates is often one of contradiction, typified by extremes. In some cultures and contexts (e.g., Hindus of Bhutan, India, Nepal) primates are viewed as sacred, in others such as China or Japan, they are mythical creatures of cunning and deviousness, while for most of the world's subsistence farmers living in close proximity to monkeys and apes, they represent a significant crop pest. In many cultures these two views overlap resulting in both a love and loathing of the creatures such that they may be worshipped at a temple and killed on the farm next door. In many places, cultural tolerance alone is protecting primate species (e.g., India, Sulawesi). It is within these perceptions and limitations that conservation must work.

In this paper, we explore issues in the perception of primates by local communities. We also address how attitudes to nonhuman primates may impact on whether pest species are tolerated or removed. Problems of a difference between perception and reality in relation to pest primates are discussed with a view to assessing the impact of attitudes on primate conservation.

WHY STUDY ATTITUDES?

In subsistence agricultural societies the nuisance value of wildlife, due to crop damage and livestock depredation, is often pronounced in people's minds [Ranjitsinh, 1984]. People feel threatened by wildlife, both in terms of crop loss and personal safety [Eley & Else, 1984; Hill, 1998, 1999; Hoare, 2000; Malik & Johnson, 1994; Sahria, 1984]. Information about the attitudes and perceptions of pest primates, or indeed any commensal species, is a prerequisite to designing optimal and effective management schemes and introducing suitable preventative measures [Else & Lee, 1986; Gillingham & Lee, 1999; Parry & Campbell, 1992; Pirta et al., 1997]. In the past,

attempts to deal with problems have run into difficulties through lack of local consultation [Strum, 1987]. The appropriate management strategy depends on the prevailing economic and cultural context, as well as conservation objectives [Naughton-Treves, 1998; Newmark et al., 1994].

For local farmers, the extent of economic loss due to primates may be less important than the belief that monkeys are responsible. The result of these beliefs is that the monkey population will be persecuted and will suffer energetic or reproductive costs and possibly mortality. It is therefore essential to address perceptions and to determine the extent of any miss-match between perception and reality.

PERCEPTIONS OF PRIMATES

One fundamental influence on perceptions of primates is the general cultural attitude of people towards primates. Levels of tolerance, acceptance and even demand for interactions vary with cultural context [Biquand et al., 1992; Burton, 2002; Gautier & Biquand, 1994]. Nonhuman animals may be viewed as brethren [Strum, 1994] and this has enabled their survival throughout much of Asia [Southwick & Siddiqi, 1977, 1994]. In parts of Northern India, Indonesia, and other areas, monkeys are worshipped, protected and provisioned by villagers. While showing remarkable tolerance, people are still reluctant to share their crops [Eudey, 1994; Jolly, 1985; Malik & Johnson, 1994; Richard et al., 1989; Southwick et al., 1961a, b, 1983; Strum & Southwick, 1986; Wheatley & Harya Putra, 1994]. This is highlighted in Japan and Thailand where monkeys are provisioned in one temple or village [Knight, 1999] and shot in the neighboring field [Eudey, 1994]. As cultural restraints protecting primates wane, intolerance and persecution become more frequent [see for example Knight, 1999; Mohnot, 1971; Southwick & Siddiqi, 1967, 1977].

Cultural perceptions of primates vary enormously and have shifted over time. Historically, primates were revered as guardians of human settlements, as spirits of ancestors, or as an embodiment of sexuality, wisdom, and fortune in areas as widespread as Cameroon to Tibet. In some societies, monkeys may even be incorporated into the kinship or cosmological belief system [e.g., Cormier, 2002]. Monkeys and apes are kept as pets, sharing household areas and food, acting as surrogate infants or dolls for young girls, or exploited for their entertainment value. This may be a converse of the human–companion animal relationship [e.g., Serpell, 1981]. Primates can symbolize human bestiality or dubious morality, possibly due to their obvious morphological similarity to humans [Knight, 1999; Morris & Morris, 1966].

One factor potentially reshaping attitudes is colonialism. European attitudes, which have no tradition of coexistence with primates, historically have been imposed on reluctant farmers. In India, the British attempted to translocate langurs and macaques when they were agricultural pests, which effectively simply shifted problems to other farms [Morris & Morris, 1966]. The impact of the colonial and neocolonial imperative for economic development and market sales of cash crops can create or enhance a context of conflict between primates and farmers who were previously subsistence farmers only. As long as crop losses due to primates were consid-

ered acceptable or normal within general crop yields, perceptions of the significance of the "monkey" problem might rank relatively low in the general context of pests (but see below). We suggest that even relatively minor losses can assume a major perceptual importance when farmers become engaged in a market economy. A cash economy also promotes a need for crop surpluses that can be sold, exacerbating the "cost" of reduced yields [see Fuentes, 2002]. It can be suggested that a Euro-centric attitude to wildlife, which veers from extreme forms of animal control to passionate advocacy of animal rights, is often at odds with indigenous attitudes [Adams, 1996]. In particular, the pest-control mentality associated with agri-business and a market economy has been exported along with the plantations. This, at least potentially, promotes contexts for negative perceptions and increases the potential for conflict.

PRIMATES AS PESTS AND IMPACT ON PERCEPTIONS

As all the papers in this book note, primates are "pests" in a huge variety of contexts - in fields, tourist lodges, reserves, roadsides, temples, or towns. One key issue is increasing competition between nonhuman primates and humans with the spread of agriculture and human activity into areas that previously sustained nonhuman primates alone. There is little quantitative work on the socio-economics of pest primates, and the importance of loss of subsistence as opposed to cash crops is unknown, either in terms of the economics of the losses or in relation to changing perceptions. However, primates dominate amongst pests that damage crops, particularly around African and Asian reserves, being responsible for over 70% of the damage events and 50% of the area of farms damaged [Naughton-Treves, 1998]. On the Mentawai Islands, macaques can account for losses of up to 35% of garden yields. Due to their intelligence, opportunism, adaptability and manipulative abilities, some species easily turn to crop foraging and make formidable crop-raiders.

The human and nonhuman primate niches overlap extensively making competition much higher between the two and posing significant management problems [Strum, 1987]. As a final point, the natural habitat of many primates, even in tropical forest areas, has a marked seasonality to secondary production, with "hungry" seasons resulting for humans as well as primates. Humans, over the course of their relationship with fruiting plant species, have selected variants that produce edible products during the human hungry season, in order to manage their energy deficits. Planting and growing patterns may make foods accessible to primates specifically at those times when there is little for nonhumans to eat. When natural foods are limited, high quality, easily digested human foods provide an alternative source of nutrition for primates, and crop-raiding may intensify [see Horrocks & Baulu, 1994].

Almost all nonhuman primate families have been identified as crop-raiders (Table I) although species differ in their ability to cope with encroaching human settlement. Crop raiding is integral to the ecology of primates inhabiting areas of human-animal interface [Naughton-Treves, 1998]. The cercopithecoids, most notably macaques, vervets, and baboons are frequent culprits. This is most likely due to generalization of diet; they are all opportunistic frugivores with enhanced intelligence and manipu-

Table I. Crop raiding species of primate, with details from specific study sites of crops and impact on perceptions.

Species	Location	Conflict context	Perceptions where known
Propithecus verreauxi coquereli	Madagascar	Cashew fruit, mango, tamarinds	Protected or sacred (*fady*) in some areas
Lemur fulvus	Madagascar	Cashew fruit, mango, tamarinds	
Avahi laniger occidentalis	Madagascar	Cashew fruit, mango, tamarinds	
Leplilemur mustelinus edwardsi	Madagascar	Cashew fruit, mango, tamarinds	
Perodicticus potto	Cameroon	Raids gardens for fruit	No negative impact on perceptions as such. Losses are not great and are attributed by villagers to other animals
Galago alleni	Cameroon	Garden raider	Few negative perceptions reported
Callitrix jacchus	Brazil	Raids fruit plantations	
Cebus apella	Northern and central South America	Raids fruit plantations throughout their range	Kept as pets; hunted
Macaca mulatta	India, Nepal, Pakistan, China	Raids wheat and rice fields, edible crops	Pest; Weed species
Macaca radiata	India	Edible crops	Weed species
Macaca fascicularis	Borneo, Malaysia, Mauritius, Sumatra, Thailand	Damages sugar cane, vegetables, fruit and rubber plantations	Weed species; major pest where introduced as on Mauritius; used for tree crop harvesting

Table I. (Continued)

Species	Location		
Macaca sylvanus	Gibraltar, North Africa	Provisioned for tourists; potential health problems through contact with humans. Population expansion due to provisioning	Tourist attraction
Macaca assamensis	Nepal, Thailand	Edible crops	
Macaca fuscata	Japan	Crop raider in past; provisioned at feeding sites	Tourist attraction; population explosions require management
Macaca nemestrina	Indonesia, Malaysia, Thailand	Plantations	Used for harvesting coconuts
Macaca cyclopis	Taiwan	Crops; provisioned	Tourist attraction in some areas
Macaca sinica	Sri Lanka	Crops	Weed species
Macaca nigra	Sulawesi	Garden raider	Pest with some incorporation into traditional belief systems
Macaca arctoides	China, India, Thailand	Crop raider	Pest
Macaca pagensis	Mentawai Islands	Garden raider; sweet potatoes	Pest and part of belief system
Papio anubis & P. cynocephalus	Kenya, Uganda	Raids maize, banana, cassava, and cashew crops as well as fruit. Raids garbage, houses and lodges. Use of "deceptive" tactics demonstrated	Viewed as malicious, cunning, and dangerous

Table I. (Continued)

Papio hamadryas	Saudi Arabia, Ethiopia, Eritrea	Raids garbage and crops	"Sacred" baboon; dangerous pest species
Papio ursinus	Southern Africa	Crop and garbage raider	
Mandrillus sphinx	Gabon, Cameroon	Raids manioc	Intensely hunted and valued for meat
Mandrillus leucophaeus	Nigeria, Cameroon	Plantation raider	Intensely hunted and valued for meat
Theropithecus gelada	Ethiopia	Rare raiders of wheat farms	Shot for manes for use in traditional dress
Semnopithecus entellus	India	Raids mainly large fruit trees	Sacred primate to Hindus
Colobus guereza	Uganda, Kenya	Fruit plantations; cashews	
Procolobus kirkii	Zanzibar	Coconuts, other plantations	Pest, but shown to be beneficial to growth
Cercocebus torquatus	Congo, Nigeria, Cameroon, Guinea, Gabon	Garden raider; peanut crops	

Table I. (Continued)

Cercocebus atys	Ghana, Guinea, Ivory Coast, Sierra Leone, Liberia	Cocoa plantation raider; garden crops	
Cercocebus galeritus	Cameroon, Gabon, Congo, DRC, Uganda, Tanzania, Kenya	Rice farm raider; garden crops; forest plantations	
Cercopithecus cephus	Gabon, Cameroon, DRC	Regular crop and garden raider	
Erythrocebus patas	East Africa	Occasional farm raider; rapid at escape	
Cercopithecus aethiops	Cameroon, Kenya, Malawi, St. Kitts	Raids maize, banana and cassava or field crops mainly. Often resident on farms	Considered "Vermin" and a major weed species
Cercopithecus ascanius	Uganda	Raids maize, banana and cassava mainly	
Cercopithecus mitis	Kenya, Uganda, Zanzibar, S. Africa	Crop and plantation raider; tourist lodge / camp raider	Considered a major pest species

Table I. (Continued)

Cercopithecus l'hoesti	Uganda		
Gorilla gorilla berengei	Uganda, Rwanda, DRC	Raids field crops, increased due to loss of fear of humans through habituation	Considered quiet animals, generally fairly afraid of humans. Valuable in context of eco-tourism
Pan troglodytes	Uganda, Tanzania, Cameroon	Raid maize, banana, cassava, sugar carne and field crops	Considered dangerous and / or sacred in some areas

Adapted from Priston [2001], with additions from Hill [this volume], and Lee (personal observations).

lative capabilities [Gautier & Biquand, 1994] and many are forest-edge species [Chivers, 1986]. Richard & Goldstein [1981] and Richard et al. [1989] have classified macaques according to their ability to exploit human resources as weed or non-weed species and consider this a major determinant in their initial dispersal, current distribution, and evolution. A "weed species" is defined as a species that depends on and competes with humans through much of its range, whereas non-weeds reach highest densities in forests with little or no human contact [Richard et al., 1989]. Classification as a non-weed species does not mean that raiding activity is not exhibited; all macaque species crop-raid even if infrequently, including the more reclusive species, e.g., *M. cyclopis* [Richard et al., 1989].

Rainfall, season, crop variety and characteristics, wild-food availability, distance from forest, nearest farm or village, and farm protection methods will have an impact on raiding [see for example Biquand et al., 1992; Gautier-Hion et al., 1985; Hill, 1999; Horrocks & Baulu, 1994; Lee et al., 1986; Maples et al., 1976; Mohnot, 1971; Musau & Strum, 1984; Naughton-Treves, 1998] and the raiding frequency and intensity will feedback into attitudes towards the primates.

Troop size and individual characteristics of the primate (age, sex, experience, etc.) may also be important. In olive baboons, young, adolescent males are more frequent raiders [Forthman Quick, 1986a; Oyaro & Strum, 1984; Strum, 1986, 1994], and these individuals can be perceived as dangerous and aggressive. Raiding is a high-risk activity and raiders suffer greater mortality and morbidity [Strum, 1986], with some primates being simply eliminated [Naughton-Treves, 1998].

One significant issue that is rarely addressed is how well attitudes match with the extent of damage caused by primates. Relatively few studies have attempted to either quantitatively or qualitatively examine the potential for a cause and effect relationship between damage and perception, and this is an area that needs further research. Negative attitudes are a function of the degree of contact with primates as pests, and to a lesser extent with the risks perceived to result from direct primate-human contacts as noted above. Brief contact with monkeys in the absence of crop damage tends to promote positive attitudes [King & Lee, 1987; Knight, 1999], while even minimal experience of raiding leads to an attribution of blame that may greatly outweigh the extent of the damage [Chalise, 2000; Chalise & Johnson, 2001; De Boer & Baquette, 1998; Hill, 1997, 1999; Naughton-Treves, 1996, 1997; Priston, 2001; Siex & Struhsaker, 1999]. It should be noted that societal expectations (myth, religious belief, economic or political contexts) establish initial principles for how humans are "expected" to behave towards monkeys [see Sponsel et al., 2002]. The subsequent experience of those people with monkeys is thus layered on a series of beliefs and expectations to produce perceptions of monkeys and thus to impact on attitudes.

Interestingly, primates are often perceived of as intelligent, vindictive, and malicious – causing damage for the sake of damage [Chalise, 2000; Hill, 1997; Knight, 1999; Naughton-Treves, 1996]. Large size, large canines, and aggressive raiding strategies used by key raiders such as adult males [e.g., Strum, 1986], or the presence of large groups [e.g., Hill, 1999], increase the perceptions of risk to people in human-

primate conflicts. Risks of attack or injury are significant issues in general when attempting to assess attitudes to wildlife crop pests and how these influence conservation goals or management programs. Perception of risk tends to focus on large, conspicuous or dangerous species such as elephants and primates, even when events of raiding are rare [see also Gillingham & Lee, 1999; Sukumar, 1990].

Another key issue is that of compensation. When farmers have opportunities to claim financial compensation for crop damage, there is a tendency for primates to be "blamed" for damage that may be over and above the damage these species inflict [Gillingham & Lee, in press; Naughton-Treves, 1997; Siex & Struhsaker, 1999].

CONFLICT AND EFFECTS ON PRIMATE POPULATIONS

In most primate range countries, the major threats to populations are due to the extensive conversion of primate habitat into areas of human use (agriculture, forestry, plantations), trapping for the biomedical trade and most recently, the effects of the bushmeat trade and disease [Lee et al., 1986; Walsh et al., 2003]. However, historical declines, even when associated with other pressures, were marked in those areas where primates and humans were in potential conflict over crops. For example, although the major decline in the population of rhesus monkeys in India in the 1960s was due to trade in live animals for experimentation, the population decrease was most marked in agricultural areas. Southwick et al. [1983] reported an 89% decrease in village populations of rhesus macaques and 76% in canal bank groups, both of which were frequent crop raiders. They attributed the distribution of the losses to changing human attitudes and agricultural expansion, which placed the rhesus into closer contact and conflict with humans. Interestingly, Southwick et al. [1980] noted that some groups were protected by human "caretakers" in some areas, but outside these areas the humans were unable to prevent trapping.

The live trapping or complete removal of groups of monkeys has had major consequences for a number of other species [e.g., baboons: Rowell, 1968]. Green & Minkowski [1977] note that in the Ashambu Hills, South India, hunting to kill or capture lion-tailed macaques has resulted in few surviving populations. Coupled with habitat loss (for plantations), this species is now endangered. Uncontrolled demands for medical and pharmaceutical research, shooting and trapping, and changes in local traditions protecting monkeys in agricultural areas have led to the loss of or vulnerability of populations of stump-tailed macaques over much of the species' range [Bertrand, 1969].

In Mauritius, where long-tailed macaques were originally introduced by people, recent habitat loss and agricultural encroachment have magnified human-primate conflict. It is estimated [Bertram & Ginsberg, 1994] that *M. fascicularis* causes >£1 million (US$ 1.5 million) in agricultural damage per year and extensive trapping for export to the biomedical trade is considered the only effective way to control population size and reduce damage. On Barbados, a seven-year trapping program was used against introduced vervet monkeys as a means to prevent crop-damage and to develop the vervet as a valuable financial resource [Horrocks & Baulu, 1988, 1994]. The farm-

ers were paid specifically for monkeys trapped on their land. Although the vervet population remained constant, the proportion of juveniles to adults increased markedly in contrast to demographic changes typically observed as a function of habitat destruction. The trapping program corresponded with an increase in complaints over crop damage, which may have resulted from a diversification of crops, providing more monkey-palatable foods, as well as to an increase in the damage caused by a larger number of juveniles who are inefficient foragers. However, during the scheme, the use of vervets as a tourist attraction, and the fact that culling has taken place has led to some improvement in attitudes towards the vervets.

Another significant problem relates to primates that are provisioned by people when people seek contact with monkeys. The monkeys develop a taste for human foods, lose their fear of humans, and then become proactive (and aggressive) in seeking human foods. This is a particular problem for tourist lodges, camps, temples, or monkey feeding sites such as those in Japan, China, or on Gibraltar [see for example Brennan et al., 1985; Else, 1991; Fa & Lind, 1996]. This conflict is particularly interesting in that it arises from a positive desire to contact monkeys and then people discover that the contact poses risks from bites, theft of non-provisioned food, or more general health issues such as exposure to simian viruses [see Else, 1991]. In contrast to situations of direct conflict over livelihoods, which produce negative perceptions of primates, here positive attitudes are responsible for the creation of a pest primate problem. Inadvertent opportunities for kitchen theft, garbage raiding, or from intentional human provisioning may result in population increases, exacerbating the existing problems, and the monkeys are then at risk of culling or complete removal [e.g., Fa & Lind, 1996; Strum, 1986].

A more general conservation issue for primate populations relates to the potential for indirect conflict between primates and livestock that forage on similar resources. The impact of livestock on terrestrial vegetation has been proposed as a significant competitive pressure on primate populations as diverse as Barbary macaques [Drucker, 1984], yellow baboons [Altmann, 1974], olive baboons [Strum & Western, 1982], and vervet monkeys [Struhsaker, 1973]. Where people increase stocking rates in relation to natural vegetation availability, to enhance returns of meat, milk and other animal products, primates may be squeezed out or suffer reduced reproductive rates by the far more effective offtake of human-managed livestock movements through the area. While the human herders may not have a perception of monkeys as pests, the indirect competition can drive monkeys into habitats, such as forests or plantations [e.g., Ciani et al., 2001], where they then cause significant damage and become "pests."

The issue of conflict and perceptions is particularly pertinent on Madagascar, where the majority of the lemurs are currently threatened species. People arrived there only 1500-2000 years ago, bringing with them a mixed tradition of rice-growing and cattle-raising – neither of which are indigenous to Madagascar and both of which have contributed to the extensive forest loss (over 80%) seen today [Mittermeier et al.,

1994]. The human population density is not as great as in some other developing countries but the population growth rate of 3.1% is probably unsustainable in a country that is 80% dependent on small-scale agriculture.

Reports of crop-raiding by the Malagasy primates are few and often limited to anecdotal observations. Certainly a number of species do raid: e.g., *Lemur fulvus*, *Propithecus verreauxi coquereli*, *Lepilemur mustelinus edwardsi, Avahi laniger occidentalis* [Ganzhorn & Abraham, 1991] and also the aye-aye (*Daubentonia madagascariensis*) [Anonymous, 1964]. Thus, these species are sometimes killed over crop conflicts. However, the aye-aye is also regarded as an evil omen and may be hunted for that reason [Fitter, 1974].

Propithecus tattersalli has been hunted severely for food and ritual practices, which has eliminated it from many of its previous habitats. However, coexisting with a tradition of hunting is a strong tradition or taboo known as *fady* that prevents hunting of some animals. The species protected vary from place to place. For example, the killing of indris is forbidden among the Betismasaraka people of the Eastern rainforest and *Propithecus v. verreauxi* is *fady* amongst the Antandroy and the Mahafaly of the spiny desert [Mittermeier et al., 1994]. With an increasing human population and shifting occupation of areas by groups of people with different traditions, *fadys* are being abandoned or forgotten. The movement of people into areas where lemurs are unafraid of people (due to previous *fadys*) may result in rapid local population extinction. An old attitude when replaced with a new tradition of exploitation becomes a significant conservation issue.

MANAGING CONFLICT AND CHANGING ATTITUDES

In general, primate conservation goals often conflict with human economic interests [Southwick & Blood, 1979]. Some species adapt well to disturbed habitats (e.g., some of the Callitrichids or nocturnal species such as pottos), while others require undisturbed mature forest (e.g., *Lagothrix* or *Brachyteles*). Managing the threats to primate populations with regard to conflicts with humans requires a reconciliation of these conflicts, as well as the recognition of habitat requirements of different species. Obtaining the cooperation of local people in efforts to both conserve and control pests is a significant mechanism for sustaining primate populations. In this regard, understanding attitudes and working through conservation education to affect attitudes may be key to preserving primates in areas adjacent to humans. As we discussed above, studies of attitudes are relatively rare, while studies of the interaction between perceptions and primate pests are even fewer. Thus, attempts to control "problem" primates need to proceed on a case-by-case basis.

Traditional methods to prevent primate crop-raiding (Table II) generally have only a limited success. The dexterity, deceptive skills, and intelligence of some primates make containment and control costly, inefficient, and ultimately ineffective [Maples et al., 1976; Strum, 1986, 1987, 1994]. Tactical deception is itself a point of debate,

but in this context it is taken to mean the distraction of a farmer by one part of the troop while the other part silently raids another area of the farm [Maples et al., 1976; Strum, 1986, 1987].

Raiding has been attributed to a cost-benefit scenario whereby the benefits of reduced foraging costs and increased energy balance outweigh the risk of injury in the fields [Naughton-Treves, 1998; Forthman Quick & Demment, 1988; Strum, 1987]. The monkey's perception of risk must be increased to outweigh benefits if deterrents are to be successful. Accessibility and palatability of crops need to be reduced in an affordable and practical way but often neither the will nor the money is available to pursue such methods. The most effective short-term deterrent is guarding the fields, together with throwing missiles and perhaps using a slingshot [King & Lee, 1987; Priston, 2001]. This, however, is a considerable drain on time and may result in conflicts between activities, such as the loss of time in school if children are guarding the fields or reduced time to complete other work with consequently lost income. Long term measures that might offer some hope for conflict management include buffer zones and alteration of crop patterns, although these are not always possible when land is allocated to individuals by governments and food is grown only for subsistence. Methods such as translocation, taste-aversion conditioning, and trapping (see Table II) have the potential to be effective but rarely are: they can result in population skews when individuals or whole social groups are removed; they require the capture of animals; individuals need to be provisioned; most are prohibitively expensive. There are also major ethical considerations attached to interventions or removals. Though success has been claimed for some translocation schemes [Imam et al., 2002; Strum & Southwick, 1986], it is never without a significant expense of up to $500 per animal [Forthman Quick, 1986b].

Thus, the goals of primate conservation in areas where there are conflicts can be summarized as follows:

•Develop strategies to reduce conflict where it is a genuine problem. This requires an assessment both of the magnitude of the problem and an understanding of how attitudes relate to perceptions and reality. For example, the feeding strategy of the Zanzibar red colobus monkey in plantations may actually increase the trees' productivity. Making farmers aware that the monkeys either have a limited damaging effect, or even a potentially beneficial one, could be a major route to enhancing positive perceptions about the presence of primates in plantation areas [see Siex & Struhsaker, 1999].

•Create education programs to promote an awareness of the significance of primates, of their conservation status and how humans can help protect them. Showing an interest in the animals themselves can promote an interest from local residents. Once people realize that not everyone in the world has monkeys in their gardens and that, to many, monkeys are not considered as vermin, tolerance may be enhanced. Such strategies have worked with the Diani Colobus Project in Kenya and appear effective especially with children [King & Lee, 1987].

Table II. Methods used to deter or control pest primates and their effectiveness.

Local or individual attempts at deterrence – non-lethal

Method	Context for application	Advantages	Disadvantages
Fences/electric fences	Requires access to materials for construction and maintenance	Exclusion fences can be effective in minimizing crop loss, when designed as a complete barrier	Expensive and may require technology that is unavailable (solar panels, batteries, etc). Primates can climb or get through most barriers, and can learn to avoid electric shocks
Dogs	Requires a culture of keeping dogs and the resources to feed them	Often very effective: large or actively noisy dogs are excellent deterrents. Habituation is unlikely	Potentially expensive and a threat to children when trained as attack or guard dogs
Chemical deterrents; taste aversion conditioning	Requires knowledge of pest behavior; requires financial and logistic resources to acquire appropriate chemicals; logistics of introducing chemicals need careful consideration	Taste aversion has significant impact and effectiveness for some species	Chemical deterrents may be detectable and thus learned avoidance minimises effectiveness; conditioning can be ineffective in the long term due to learning, and species-specific tendencies to sample foods despite aversion. If chemicals are lethal (poisons), then welfare and ethical issues need consideration
Playback of alarms	Requires species-appropriate recordings and playback technology	Non-lethal and potentially effective as a short term deterrent	Individuals habituate rapidly and thus effectiveness may be short-lived. Ethical concerns about habituation if predators are also present in the environment

Table II. (Continued)

Guarding/chasing	Requires presence and active attention of guarders during periods of primate activity	Effective as long as primates are afraid of people.	Habituation to women and children may occur. Keeps people from other activities, especially when done by school age children
Noise/bells/shouting	Requires presence and active attention of guarders during periods of primate activity	Quite effective in the short term and for species that raid only rarely.	Habituation is a problem for frequent, experienced or motivated raiders
Contraception	Requires the capture of females and that implants or methods for dosing are available and can be administered by trained individuals	Effective at ensuring the problem population does not expand. Humane	Expensive; drug effectiveness is time-limited; may not address the immediate problems of conflict; can skew population dynamics with negative consequences for sociality and survival in the long-term
Painting individuals	Involves the capture of one troop member, usually the dominant male, painting him white/red and re-releasing him to frighten other troop members	Evidence from interviews suggests this works as a deterrent for several months	Probably most effective in the short term. Ethical issues with respect to potentially altering the status of individuals
Local or individual deterrence – potentially lethal			
Stones/slingshots/spears	Low technology, and typically readily available	Particularly effective and can be used to frighten rather than injure	Causes considerable damage and distress to monkeys (welfare issues); requires regular reinforcement so frequent use with a time cost to the guarder
Shooting/hunting	Requires guns and ammunition, as well as training in their use	Non-lethal (shots in air) may frighten monkeys, and acts more as noise deterrence	Obvious lethal implications; welfare is a problem when animals are left injured; legal issues in areas where the pest primate is also a Red List species (Vulnerable, Endangered or Critically Endangered). Further ethical and conservation concerns apply when raiding or pest species become a bushmeat source

Table II. (Continued)

Trapping/culling	Requires specialist intervention to supply traps or to remove individuals humanely	Effective in the short term in mitigation of problems, as experienced raiders are removed either from a group or if a group is removed, from the conflict area	Can result in "mining" populations as new groups move into the empty habitat. Significant welfare, ethical and legal issues associated with removals and the future of trapped animals
Translocation	Movement of groups or individuals requires technology for trapping, transport and release; need for suitable unoccupied habitat that can be found for the release; some provisioning and follow-up monitoring are often required	Moves species or individuals of specific conservation concern out of conflict regions	Often very expensive; monitoring of post-release is time-consuming; ethical considerations of placing individuals into a completely unfamiliar environment which may pose unexpected mortality risks
Large scale conservation or management schemes			
Cropping patterns	Alter crops grown and the timing of planting and harvesting	Makes crops less available relative to natural foods; decreases reliance on human foods	Causes disruption to traditional agricultural practices; may be impossible relative to seasons
Buffer zones	Regions of partially cleared land surrounding farms or buffers of less desirable crops planted to make access to fields more difficult. Needs communal entitlement to buffer zones	Particularly effective when barrier crops are grown for "sacrifice" and there is no expectation of yield	Difficult to initiate when specific areas of land are allocated to people and when yields are already marginal.
Conservation of forest refugia	Keep forested zones adjacent to farm areas	Preserves habitats, natural foods, and other resources for sustainable extraction. Protection of many other vulnerable species of plants and animals	Acts as a reservoir for pests; distance to forest is a major predictor of farm damage. Refuge areas need to be extensive in size to protect populations

ᐧInitiate local community schemes to increase dialogue, and promote positive benefits [e.g., Infield & Namara, 2001], such as the conservation of local non-timber forest products, watershed protection, biodiversity, etc. Revenue generation from wildlife is thought to hold the potential to ameliorate conflict and changes attitudes from negative to tolerant or positive, and thus primate ecotourism is another means of producing local benefits [see Boulton et al., 1996]. While highly successful with the charismatic great apes [Harcourt, 1986; Plumptre & Williamson, 2001; Stanford, 2001], political instability, a variable tourist market, and a lack of direct returns to local communities may make such projects difficult to sustain in the short term. Furthermore, there are risks to the primates and the people when there is the potential for infectious disease transmission due to close contact [see Lilly, this volume]. While this can be addressed via strictly enforced limits to close encounters, it requires additional regulation and cooperation on the part of the tourists. All of these issues can detrimentally affect the long term future of ecotourism and thus of the primates when local people rely on wildlife as a source of revenue.

CONCLUSION

In conclusion, without an appreciation of the human dimension to problems of conflict with primate populations, sustaining primates outside protected areas may be impossible. However, for future generations of both nonhuman primates and humans, strategies to manage and contain conflict are urgently needed. These strategies must relate to human needs as well as primate needs in order to be effective over the long term. There are significant ethical issues that need to be addressed in all management strategies – many primates are highly social and cognitively complex. Disruption of their social systems in the short or longer term by management strategies based on removal could have catastrophic impacts on the remaining individuals, both in terms of reproduction and social stability. Many species involved in crop-raiding, and indeed almost all of those on Madagascar, are of major conservation concern, being vulnerable or endangered. Management of conflict thus needs to ensure that these species are not subjected to greater pressures leading to local extinction. And finally, while local needs for protecting food supplies or economic returns from forest products, including non-timber forest products, must be recognized, the value of protecting buffer habitats for **both** the humans and the primates needs to be emphasized in management plans.

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