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Management of Primates as Crop Pests in Africa and Asia

The relationship between humans and primates can be a complicated one because of primates' roles in different cultures and societies. While in some cultures they are viewed as sacred or mythical creatures, farmers who live near monkeys and apes consider them a significant crop pest (Lee and Priston 2005). Unfortunately, wildlife as agricultural pests have become a widespread problem throughout the world. Human-primate interactions were not a severe problem in the past, but conflicts have intensified in recent decades due to agricultural, irrigational, & industrial projects; increased urban expansion; and fragmentation of natural forested areas as human population increases (Wijethilaka et. al 2021). As habitat fragmentation and destruction becomes more widespread, primates begin to encroach farms and agricultural territory in search of alternative food resources. These human-wildlife conflicts affect the survival of many endangered commensal species, like Colobines, a subfamily of leaf-eating monkeys found in Africa and Asia, as well as undermine local human populations' food security and tolerance for wildlife.

Primate conflict typically consists of crop raiding and damage to personal or local property, such as roof tiles, power lines, and fencing (Nijman 2021). When surveying individual households in Sri Lanka, researchers found that the highest number of households were affected by damages done to fruits, leaves, & buds of commercial value (93%), breaking of roof tiles (76%), and frightful encounters (43%) (Wijethilaka et. al

2021). One of the important factors to consider when investigating the economic implications of primate conflicts is the fact that many rural and agricultural African and Asian economies are vastly different from economies and incomes we are used to seeing in developed countries. In 2011, the distribution of household income in two coastal cities in Sri Lanka, adjusted for inflation in June 2021, saw about 80% of people earning less than US$160–180 month. The reported monthly cost, corrected for inflation in June 2021, of damage due to Western Purple-faced Langur and Toque Macaques in Colombo, Sri Lanka ranged a monthly average of US$10.05- 18.10 (Nijman 2021). That's up to potentially almost 10% of monthly income lost due to conflict with primates. Crop destruction is costly with issues like crop loss, increased need to guard fields that causes labor bottlenecks, disruption of schooling because children are needed to help guard fields, injury risk, and zoonotic disease risk (Hill 2004). With little help from government organizations, many farmers are left to deal with pests themselves.

Nonhuman primates are serious pests in tropical areas partly because of their intelligence, adaptability, and opportunistic tendencies. Members of the genera *Macaca*, *Papio* and *Cercopithecus* are amongst the most frequently cited primate pest species, with the three most notorious pests being the rhesus monkey (*Macaca mulatta*), the yellow baboon (*Papio cynocephalus*) and the vervet monkey (*Cercopithecus aethiops*) (Else 1991). These primates all have complex social organizations, are highly omnivorous and, while primarily terrestrial, utilize arboreal habitats. Successful pest species are highly social and have high intelligence, communication skills, dietary and behavioral flexibility, manual dexterity, and extreme agility (Else 1991). These traits make it difficult for farmers to protect their crops and render passive methods of control

ineffective, such as exclusion from agricultural land by physical barriers. Primates can climb over and through most forms of barriers and are quick to learn how to evade electric fences (Hill 2005). The only techniques that have been proved even somewhat successful are chasing, shooting, trapping, and poisoning the animals, but these measures are wasteful and of limited value, mainly because primates are such fast learners (Else 1991). Even more problems arise when the animals causing crop damage are protected species. Farmers are more restricted in the way they can respond to crop raiding and their traditional methods of crop protection often come under fire or are considered unlawful.

Understanding the patterns of primate crop damage requires careful attention on both a spatial and temporal scale. Given that forests are being fragmented and converted to agriculture throughout East Africa and South Asia, adaptable primates such as baboons and other Old-World monkeys may become highly destructive to forest edge crops (Kavanagh 1980). Furthermore, the long-term survival of primates is at risk from low human tolerance for 'pests' and the potential impact of primate habitat destruction. Various factors can contribute to people's declining tolerance of local wildlife, including increased dependence on agriculture for livelihood, declining alternative employment opportunities, and influence of past and present conservation and wildlife management strategies (Tweheyo et. al 2005). Traditional control strategies tend to focus on eradicating pest species and while this has proven effective in industrial countries, developing countries have a harder time adopting these methods for several reasons including a greater number of pest species, lack of financial means, and lack of advanced technologies and methods.

Obviously, human–wildlife conflict mitigation should begin with understanding farmers' perspectives. Mitigation strategies must consider not only the degree to which wildlife conflicts affect crop yields and household economics, but also how and why people perceive crop losses the way they do, what they expect from any intervention, and who they expect to take responsibility for the issue. In a study of 40 farms in Uganda, average losses due to wildlife ranged from 27%-60% of farmers' annual harvest (Hill 2004). Protections put into place by the Ugandan government prevented farmers from shooting primates on their farm, taking away what they believe to be the most effective form of pest control. From the farmer's perspective, the Ugandan government behaves like an irresponsible livestock owner where wildlife is concerned. Government laws determine what people can or cannot do with wildlife, and these laws are enforced. Yet, the government does not ensure that its wildlife is prevented from entering fields, as is required by a responsible livestock owner. It also does not provide compensation when crop losses do occur (Hill 2004). When conservation policy and practice prevent or discourage farmers from taking direct action against crop-raiding species, farmers may expect government agencies to assume responsibility for providing adequate crop protection against wildlife.

If farmers can't shoot the pests on their property, what are they expected to do? Understanding how crop raiding behavior fits into overall foraging strategies and the ecology of pest species populations can help managers develop methods to resolve this conflict. Non-lethal methods of management require even more investigation but there is a myriad of options that vary by species, location, and crop. Some of the more common practices in place include guarding and scaring, fences and barriers, repellent

systems including capsicum repellents, and translocation (Osborn and Hill 2005). While some methods are more effective than others, the degree to which they are depends on the circumstances under which they are implemented.

Farmers and villagers will guard against primates by patrolling fields and chasing away observed animals typically by shouting and banging objects to make loud noises. They use a range of noisemakers from beating drums and tins, cracking whips, yelling, and whistling. Many times, noises are accompanied by burning fires, shooting firecrackers, throwing rocks or spears, using dogs, or using bows and arrows. Farmers will also work together and chase animals away from neighbors' fields as well as their own. Although the degree to which these methods are effective is relatively unknown and difficult to quantify, some studies suggest that intensive guarding is at least partially successful because primates avoid farms that are intensively guarded. In fact, many farmers see guarding as a necessary crop protection activity, especially against diurnal primates (Osborn and Hill 2005). However, guarding has many social implications and complications for families living among wildlife. Children and teenagers are particularly vulnerable, losing sleep or risking animal attacks when walking to school early in the morning. People who guard fields are also at increased risk of being injured by animals or contracting malaria.

Systems that exclude pest animals through barriers or fences can be very expensive and must be constantly maintained. Primates quickly learn to navigate and avoid electric fences, and walls or ditches are ineffective because of their agility and climbing skills (Osborn and Hill 2005). However, electrified fences have been used successfully at several chimpanzee sanctuaries in Africa to retain animals within large

enclosures (Kabasawa in Osborn and Hill 2005). Areas must be kept clear of vegetation on either side of the fence to prevent animals using overhanging branches to move across. This suggests that fencing is a better option for restraining larger, less agile primates such as Great Apes, than for baboons (*Papio* spp) and guenons (*Cercopithecus* spp) that can jump considerable distances.

Repellent and deterrent systems, including the use of capsicum sprays, aim to frighten an animal from a protected are through visual or chemical means. Visual repellents can be thought of as 'scarecrows,' and are usually constructed of dolls or sometimes dead primates. While met with some initial success, animals soon become used to them and visual repellents alone have no significant impact on crop raiding (Osborn and Hill 2005). Chemical repellents, however, show more promise. Forthman-Quick (1986) studied taste aversion in crop raiding primates by injecting baboons with lithium chloride, which makes maize crops taste like salt, inducing vomiting. This method led to maize avoidance for up to three months with a single application. In another study in Japan, primates were given different foods over several trials and then injected with cyclophosphamide, another chemical used to induce vomiting when ingesting certain foods. When released back into the wild, the animals avoided the foods associated with vomiting and some even avoided foods that were control foods in the trials (Matsuzawa *et al.*, 1983). Taste aversion is worth further investigation when it comes to problem primates, with careful design to ensure that the animals are responding to what we need them to. The use of capsicum fruits directly on crops have also been shown to have effects on baboons, macaques, and langurs as it reduces crop tastiness when sprayed as a solution (Osborn and Hill 2005). Placing the fruits directly

into the crop fields also deterred pests, not limited to primates, due to its unpleasant taste and aroma.

Translocation is another complicated tool used in lieu of lethal management. Aside from being costly in terms of time and money, translocation is highly stressful for animals and is unlikely to be successful except in very specific scenarios. Any primate family being moved must be moved to an area that has suitable habitat and lacks agricultural activity, otherwise the problem of crop raiding is just transferred to a new area, not to mention that fact that incoming animals may introduce the strategy to any native animals. There must also be adequate natural resources such as food, water, and shelter available to for the incoming group as well as any populations already at the site. Efforts that require the recapture of animals makes the process impossibly expensive and while some examples have been successful, it is never without significant expense, sometimes up to $500 spent per animal (Forthman-Quick 1986). Ultimately, translocation should only be looked at as a 'last-resort' solution under extreme conditions, such as when the animals involved are highly endangered.

While diving into the literature and exploring how locals feel about a group of animals I am fascinated by, I realized that outsider perspectives do not always contribute to progress when it comes to managing nuisance animals. While there are several nuances to keep in mind when tackling this issue, I believe the most important thing to keep in mind is how everyday people are affected by primates. I feel that as a society and as humans, we want to stray from lethal management as much as possible even though this method of management has been proven to be successful across numerous examples of managing nuisance species. While I am usually of the same

mindset, it's important to realize that not everything is as straightforward as we would like it to be.

While effective as a short term-solution, lethal management methods have not been proven to successfully reduce crop losses from primates (Osborn and Hill 2005). Lethal control methods that are not species specific, such as traps or poisoned bait, aim to target common species but often affect protected species and sometimes result in disfigurement or mutilation instead of death. For instance, the use of snares on the Budongo Forest Reserve chimpanzee population resulted in significant portion of resident chimpanzees showing evidence of permanent limb damage from snares (Waller and Reynolds, 2001). On the other hand, these methods can sometimes be successful, such as in Japan, where large numbers of macaques are shot each year as part of a government control program to protect orange groves and other agricultural crops (Sprague, 2002). While large scale control hunting or trapping can be an effective means of reducing conflict between primates and farmers in some scenarios, it can be a costly venture and needs to be continued and regulated over time.

Wildlife damage control is, essentially, the practice of trying to reduce the impact of a particular species' natural habits on something that humans value. It is a never-ending means to accomplish a goal. If the objective is to reduce conflict, then raising tolerance for damage is as important as reducing the damage itself. No single management option will stop all animal conflict situations. Federal mediations suffer from logistical problems, and traditional methods are generally ineffective. Most interventions aimed at reducing crop-loss come from organizations outside of the affected community, including government wildlife agencies and external development

organizations. Farmers expect the conflict to be resolved and often turn against the responsible agencies when it is not. There is no clear answer to whether lethal control methods are better or more effective than non-lethal methods, since every management technique comes with its own caveats and nuances. When endangered or protected species are the ones causing damage to crops, the issue becomes even more complicated. Where do we draw the line? Can a line even be drawn? With all the complications that arise with different mitigation methods, is it possible to find a solution that keeps primates away from crops while protecting their species' survival?

One of the main concerns that comes with this discussion and the issue of crop-raiding is the lack of understanding and empathy on why primates engage in this behavior in the first place. The crop-raiding behavior of primates is a symptom of wider dysfunctions including overgrazing, deforestation, and predator destruction; problems that can only be properly dealt with at a national level. While deterrent solutions can only be short term, they do help alleviate primate pressure while fundamental corrective actions are implemented. I believe our focus going forward should be controlling causal factors while monitoring the effects of our actions. We must address our own involvement in causing this problem before trying to find a solution.

Serious ecological changes have been prevalent in countries where primates are endemic because of an increase in human population and expansion of agricultural land (Else 1991). In Africa, most of the land was occupied by wildlife and species that have been unable to adapt to the changing environment are forced into consistently shrinking habitats or threatened with extinction. Not all primate species can adapt to these environmental changes and the ones that are able to make the adjustment to a different

habitat often become pests. The adaptive behavior of primates allows us to study and monitor changes in a primate's behavior as it relates to changes in its physical environment. Understanding this process gives practical insights into diverse topics including the flexibility of an individual's development as it relates to their environment, the intellectual and cognitive abilities of a given species, and on the management side, new techniques to control primate pest problems.

In the context of developing new managerial strategies, it can be difficult to explore options that haven't already been examined. However, some alternative methods not previously discussed have been gaining traction in recent decades.

After urban development began in the mountains of southwest Saudi Arabia, local populations of Hamadrya baboons (*Papio hamadryas*) have become increasingly dependent on food sources around cities. Biquand et. Al (1994) analyzed the root of human-baboon conflicts to try to develop a management program to minimize conflict without jeopardizing the future of the baboon population. The fundamental objective of the proposed plan, unlike others, was to reverse the *causes* of increased conflict, something that the authors of this study knew could only be achieved in the long term. In the meantime, they explored techniques to minimize conflict. They examined strategies with and without trapping, as well as population control, something that is seldom discussed in similar studies. Solutions with and without trapping saw varying degrees of effectiveness, many with restricted applications due to federal or local government regulations. Interestingly, population control methods, including male vasectomy and female fertility control, proved to be effective in lowering reproductive rates in fast growing commensal groups of baboons. Reducing the population of

primates around large cities, where an abundant and reliable food supply is available, seems like an obvious solution but the issue arose when considering how exactly to achieve that. Simply culling populations would be ineffective because more primates would just come to take their place. However, controlling reproductive rates of commensal groups is a strategy that is worthy of further exploration.

It has become progressively clear that any potential solution is ultimately situation and species specific; there is no "one-size-fits-all" plan to reduce conflict between humans and primates. As we go forward with trying to find a common ground between human and primate conflict, we must remember that any plan put into place must benefit farmers whose crops are being affected while ensuring that primate populations are not inherently put at risk.

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