

## WHY COMPENSATING WILDLIFE DAMAGES MAY BE BAD FOR CONSERVATION

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**Abstract.** In an effort to attenuate human–wildlife conflict and promote conservation of charismatic megafauna, compensation programs for wildlife damages have been implemented in many countries. Compensating pastoralists and farmers for damage caused by wildlife reduces hunting pressure on wild animal populations. However, it can also lead to a decrease in efforts to prevent damage and exacerbate conflicts with wildlife. Furthermore, compensation programs increase the return to agriculture and can therefore be viewed as a subsidy toward crop and livestock production. Such subsidies can trigger agricultural expansion (and habitat conversion), an inflow of agriculture producers, and intensification of agricultural production. Each of these impacts is shown to have potentially adverse effects on the wildlife population that compensation intends to favor. In some circumstances, the net effect on the wildlife stock could be negative. This calls for a careful assessment of local ecological and economic conditions before compensation is implemented. Incentive mechanisms that are directly tied to conservation outcomes (e.g., payments to locals based on the size of the wildlife population) should be considered instead of compensation programs.

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As human populations grow, they increasingly encroach upon natural habitat and expose themselves to several forms of human–wildlife conflict. Pastoralists and their livestock share habitat with predators that routinely take down domestic animals. Peasants find their fields invaded and their crops trampled or eaten by ungulates or primates. The economic (and emotional) costs of those conflicts can be quite substantial—from merely significant at the national or regional scale (e.g., Deodatus 2000) to outright disastrous at the level of affected household.

It is perhaps no surprise that outraged and frustrated farmers and pastoralists often seek revenge for such damages. Naughton et al. (1999) wrote that farmers in Tanzania and Zimbabwe ranked pests (including wildlife) first among 30 obstacles to the improvement of their quality of life. Mishra et al. (2003) mentioned a deep resentment of large carnivores among Indian and Mongolian pastoralists. Despite the fact that wildlife can also confer tourism and trophy-hunting benefits to rural communities, Naughton et al. (1999) argued that human–wildlife conflicts are a major obstacle to community support of regional conservation initiatives. In the same vein, Boyd et al. (1999) concluded that in the semi-arid rangelands of eastern Africa, the costs of living with

wildlife exceed the income generated from integrated wildlife management programs.

So, while traditional hunting yields bushmeat and other useful or tradable animal parts—commodities that often are highly valued locally or provide external income—the risk of wildlife-imposed damage provides strong additional incentives for farmers to hunt in order to keep wild animal numbers down and damages low (Bennett 2000). The issue becomes especially problematic when endangered or charismatic species like elephants, rhinos, lions, tigers, or snow leopards are threatened by hunting pressures.

When damages are caused by these icons of the international conservation movement and revenge killings contribute to their demise, concerns over the wildlife stocks may warrant direct intervention. To this end, international conservation groups (and national governments alike) have sought to neutralize some of the economic incentives leading to nuisance or revenge killings by setting up funds to compensate farmers for wildlife-inflicted damage (African Elephant Specialist Group 2002).

In this paper we explore the unintended consequences of compensation schemes. Building on a formal economic model developed in Rondeau and Bulte (2003), we discuss 3 possible human responses to compensation efforts and argue that many circumstances exist in which compensation for wildlife damages is actually

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detrimental for conservation. Prior knowledge of potential changes in human behavior is important when designing compensation programs if they are to yield long-run conservation objectives.

Two qualifying remarks at the outset are in order. First, we consider a simplified compensation program. In reality, compensation programs often are state-run and are followed by lethal control of offending wildlife. Many compensation programs aim at multiple objectives. Instead, we consider the simplest case where the funding agency (public or otherwise) focuses exclusively on conservation and aims to reduce “retaliatory killing” by outraged peasants. An example is the Amboseli consolation program run by the Amboseli Elephant Research Project. Under this program, pastoralists are compensated for the loss of goats and cows following lethal encounters with elephants inside the natural park. Second, we consider a very stylized social setting where humans undertake only 2 activities: hunting and cultivation. In reality, other activities will play a role in supporting rural households. Nevertheless, this simplest case allows us to home in on the main underlying mechanism and suggests a fundamental tradeoff for conservationists. The same mechanism and tradeoff will also play a role in more complex real-life settings, but possibly in a less apparent form, if peasant behavior is more complex.

### COMPENSATING WILDLIFE DAMAGES

Our basic premise is that by implementing compensation programs, the sponsor (typically a government agency or environmental organization) hopes to take away the resentment of peasants and farmers against wildlife. At the very least, it is widely believed that fully compensating for losses should mitigate the incentive to kill wild animals for defensive or revenge reasons. It is also hoped that compensation programs contribute to the building of local support for, and participation in, conservation efforts, but we leave this additional benefit of compensation programs outside of our discussion. Importantly, compensation has several merits for well-endowed NGOs funded by residents of developed countries. It can be relatively inexpensive to implement in rural areas of poverty stricken countries, and the approach is readily acceptable to local communities that can become involved in the management of compensation funds.

For these reasons, it is no surprise that programs to compensate for wildlife damages have

been implemented across the globe, affecting a wide range of species (from tigers and snow leopards to monkeys and antelopes; from elephants and rhinos to geese and wolves). However, experiences have produced only mixed evidence of success. While efforts to reintroduce and conserve wolves and grizzlies in North America have been considered a success (e.g., Rondeau 2001), outright failures have been reported from other countries—typically regions where property rights are less secure and where administrative controls are less than perfect. Many programs went bankrupt and then stopped. Such failures can be attributed to a host of reasons, including a lack of disburseable funds, bureaucratic inadequacies, and the practical barriers that mainly illiterate farmers from remote areas must overcome simply to produce a claim (Naughton et al. 1999, African Elephant Specialist Group 2002, Rondeau and Bulte 2003). Fraudulent claims also have plagued compensation programs. In some cases, farmers have cleared land, planted seeds, and left the fields untended until the end of the growing season just to submit claims of lost crops. Moreover, even in the absence of any of these considerations, it is obvious that most compensation programs remain heavily dependent on outside sources of funding, raising doubts regarding the long-term sustainability of such schemes.

Economists highlight another potential problem. When an outside agency offers compensation caused by ungulate feeding or predator kills, why would farmers make precautionary investments or incur recurrent costs to prevent such incidents from happening? Why invest in building or maintaining fences to keep predators out? Why confront a hungry elephant feasting on your maize? In economic jargon, this is called the problem of moral hazard or hidden action: compensation program sponsors are not in a position to perfectly monitor the defensive efforts of peasants, so peasants will be tempted to cut back on defensive measures and simply receive the compensation payments instead. In the absence of compensation, many preventive actions may be worthwhile investments by farmers, but the introduction of compensation removes the impetus for protecting crops and livestock. This results in levels of preventive action that are too low from society’s perspective and, consequently, excessive levels of damages.

The implications of moral hazard for damage compensation (and any other form of insurance) are in fact well known and have been considered

in the design of some compensation programs (e.g., Rollins and Briggs 1996). Recent conservation efforts therefore typically involve both compensation and a behavioral component. Compensation for lion predation in Kenya's Masailand is conditional on measurable anti-predator livestock management (construction of bomas at night and use of dogs; see Roach [2003] at [http://news.nationalgeographic.com/news/2003/07/0716\\_030716\\_lions.html](http://news.nationalgeographic.com/news/2003/07/0716_030716_lions.html)). Similarly, 1 element in a package to promote conservation of the snow leopard in India is biannual monetary rewards for "safe herding" (Mishra et al. 2003). But addressing this issue and the ones identified above is not enough to guarantee that compensation programs are successful in achieving its stated objectives of maintaining or increasing the stock of valuable wildlife.

### THREE REASONS COMPENSATION CAN BE BAD FOR WILDLIFE

In addition to the potential shortcomings and problems of compensation programs mentioned above, some of our recent findings (Rondeau and Bulte 2003) suggest that additional issues warrant much closer scrutiny of prevailing biological and social conditions before a compensation program is implemented. In this section, we describe 3 potential problems that threaten to undermine the stated objectives of compensation programs to such an extent that they may actually lead to a reduction of the wildlife stock that the program wishes to protect.

#### Allocation of Time: Habitat Effect versus Hunting Effect

For simplicity, assume the existence of a fixed group of rural households, allocating their productive time between 2 activities: (1) hunting for bushmeat or wildlife commodities, and (2) growing crops. Moreover, assume an institutional setting where access to wildlife and land is "open"—there are no *de facto* or *de jure* tenure rights for such resources. People can put as much land in agricultural production as they desire by clearing natural vegetation and encroaching upon wild lands that also serve as habitat for wildlife. Wildlife mainly occurs in wild lands not yet taken for cropping, but occasionally spills into agricultural fields to feed on crops.

This simple context is sufficiently rich to demonstrate a powerful point. Rational households will allocate their time to hunting and cropping such that, in equilibrium, the returns to

spending a little more time on each of these activities earns the same return. That is, in planning the area of field to seed at the beginning of the growing season, individuals respond to the differential in returns between the different activities. If putting an extra day in cropping is a little more profitable than going out hunting, people will sooner or later respond by reducing the time spent hunting in order to expand the time spent growing crops. Noss (1998:166), for example, noted that hunting in an area in the Central African Republic is declining because of the "growing dependence on agriculture and the necessary time investment in clearing, planting, tending and harvesting fields." People shoot fewer animals, but clear more land for agriculture. This simple observation illuminates a fundamental tradeoff in the allocation of peasant's time that is linked in important ways to a tradeoff between wildlife mortality due to hunting and habitat loss.

In the absence of compensation, wildlife damages reduce the profitability of growing crops, drive some labor away from cropping and increase time spent hunting. People shoot animals to sell the produce but also to lower the nuisance costs on their remaining fields. Now imagine that a compensation program is implemented, fully funded from outside sources. Compensation payments increase the profitability of agricultural production and thus, over time, some labor will move back from hunting to cropping. Hunting pressure will fall and fewer animals are shot than before. This can only be perceived as the intended effect; the program appears to be a success.

But to declare victory would be premature because we also have to consider developments in the agricultural sector and their consequences for wildlife. As labor flows to the agricultural sector, extra land will be cleared for agriculture. As a result, the amount of available habitat declines. This is surely not good news for wildlife. Compensation triggers 2 opposing forces. The effect of reduced hunting is good for wildlife, and the effect of reduced habitat is detrimental for wildlife.

The net effect is of course dependent on the precise economic and biological relationships relevant to a particular species and locale (e.g., the value of key economic and biological parameters such as the species' growth rate, harvest coefficients, and the amount of labor required to convert an extra hectare of habitat to agricultural field). But the take-home point is that the net effect of introducing a compensation program

could be either a gain or a loss for the species' population (see Rondeau and Bulte 2003 for a formal treatment, including stability analysis, and a fully specified model).

### Migration

The issue outlined above can be exacerbated when we take into account that compensation programs may trigger regional flows of labor. For example, it may affect long run exit rates out of the rural sector. In many rural areas in low-income countries, young people are exiting agriculture because of declining opportunities in agriculture and the lure of other alternatives. Because it makes agriculture more profitable, compensation may slow down the exodus from marginal agriculture and keep the level of human-wildlife conflict artificially high.

Compensation may also cause some migration flows toward rural areas with compensation. One simple theory of migration, somewhat akin to the famous theory of Harris and Todaro (1970), predicts labor flows from regions where earnings are low to areas where earnings are high (Ferraro 2001). Conceptually, this is akin to the equilibrating force between occupations: the only difference is that people respond by moving geographically, rather than by switching jobs within a region.

When compensation increases the income from agriculturalists in 1 region, we should expect, everything else equal, a net inflow of people from other regions. For example, people who had out-migrated may decide to come back and start cultivating abandoned fields or clear new ones. The result will be additional pressure on remaining habitats (assuming previously abandoned fields serve as habitat), mitigating or reversing any potential positive effects that compensation may have, or further deteriorating the net impact of compensation on conservation.

It may be argued that compensation programs are unlikely to be sufficiently generous to trigger migration flows. This, of course, is an open question. The Todaro-Harris model predicts that migration will occur until the marginal peasant (i.e., the peasant most likely to move as he has least to lose) is indifferent between staying and moving. While compensation programs are unlikely to affect the geographical choices of most people, it may still have an impact on individuals that are close to the margin and that are nearly indifferent between living in the program area or elsewhere. As a result, the total labor force in the program area must be considered endogenous.

Although the magnitude of the potential migration flows may be small (depending on income differences within rural society, and the income differentials between the program area and other areas), the direction of this effect is opposite the objectives pursued by a compensation program.

### Endogenous Stocking Rates and Competition for Forage

In some cases, people cannot expand their agricultural fields if, for instance, they live adjacent to a protected area. This may be the case around Amboseli NP where the objective of sustaining the local lion population clashes with the local rearing of livestock (discussed in the previously referenced online news item by Roach 2003). Even though the main mechanism highlighted above (habitat conversion) cannot take place, it is easy to reason that the impact of compensation on conservation is generally ambiguous.

Consider the setting where pastoralists near a national park have to decide the grazing intensity of their livestock (the size of the herd on the fixed available land), and where livestock competes with wild herbivores for forage. Predators primarily depend on wild ungulates, but occasionally take livestock as well. This outrages pastoralists and triggers revenge or nuisance control killings. Then assume that a compensation program is implemented. What happens?

The compensation program, when implemented in isolation, will have 2 effects. As intended, it will mitigate the incentive to destroy predators. But also, and likely unintended, it provides an incentive for pastoralists to increase the number of heads of livestock. Prior to the compensation scheme, pastoralists had to balance the gains and costs of increasing the stocking rate. Surely one component of the expected costs was the probability that the additional animal would be eaten by predators. Livestock predation, when uncompensated, reduces the profitability of raising livestock and reduces the herd size preferred by the household. With the risk of predation covered by compensation, it is optimal to increase the stocking rate. In turn, this implies that competition for forage with wild herbivores intensifies and likely that wild herbivore abundance will decline (Prins 2000). Since predators primarily depend on wild ungulates for their survival, the predator population may also be negatively affected.

Such a scenario seems to have unfolded in the Gir forests of India, which are the last refuge for the (300 or so remaining) Asiatic lions. An insur-

ance scheme designed to compensate farmers for livestock predation by lions appears to have been counterproductive at least in terms of its conservation consequences. Grazing levels and livestock losses in the forests have increased, resulting in further depletion of prey populations and increased human–lion conflicts.

## DISCUSSION

Our paper has illustrated an issue that was made in a more general context by Ferraro (2001): indirect development interventions aimed at promoting conservation may generate ambiguous incentives and could lead to a reduced wildlife population. When developing conservation packages or analyzing human–ecological interactions, the micro-economic underpinnings of human behavior should be considered. The same applies to the institutional context, as may be reflected by property rights regimes for land and wildlife resources (Bulte and Horan 2001). Our main result, that compensation can be bad for conservation, is driven by the simple insight that compensation payments are akin to agricultural subsidies and can result in an expansion of agricultural activity.

The crucial, but simple, assumption that generates these troubling results is that people respond to economic incentives by either a reallocation of labor and habitat conversion, migration, or intensification of agricultural production. It would be difficult to counter this assumption, since this is the very premise that has led to a proliferation of compensation programs.

Of course, there are cases in which the posited behavioral response is unlikely to emerge; for example, when expansion of the agricultural acreage or livestock herd is prevented by other factors. The point is not to argue against compensation programs as a tool to promote conservation. They could certainly achieve their objective. The point is that as an indirect incentive mechanism for conservation, compensation distorts other incentives that negatively impact the wildlife population, and that the net effect could realistically make compensation be detrimental to the conservation of any given wildlife population. It is therefore essential that policy makers and practitioners be aware of the potential adverse effects of compensation to prevent undesirable outcomes.

## MANAGEMENT IMPLICATIONS

Prior to implementing a compensation program, policy makers should examine whether such a program generates incentives to convert additional

land to agriculture or to increase the livestock stocking rate on existing lands. This may involve experimenting with compensation programs (with treatments and controls) to better understand the magnitude of the potential positive and negative effects. Our paper suggests that agricultural expansion, in-migration from other areas, and developments in the stocking rate should be closely monitored. When the negative effects are sufficiently important, compensation programs may be complemented with various elements to preclude the adverse effects, for example through making payments conditional on limits to habitat conversion or expansion of the stocking rate.

It is important to note that alternatives exist to compensate for wildlife damages. For example, direct payments to affected communities based on predator abundance, not damages, may be preferable. In other words, rural communities may be compensated for the various eco-services that they produce (e.g., by not converting habitat). National governments and international development and conservation agencies are increasingly experimenting with this approach (e.g., Pagiola et al. 2002). In other cases, complementing compensation payment schemes with institutional reform may be optimal. Addressing the lack of property rights to land and wildlife that encourages wasteful use of resources may prove successful. Finally, when the negative effects of compensation are larger than the positive ones, governments interested in promoting conservation may find it optimal to tax rather than subsidize agriculture.

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