CONSERVATION AND WEALTH ASYMMETRIES AMONG EAST AFRICAN PASTORALISTS

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ABSTRACT

Controversy exists among anthropologists, conservation biologists and development workers as to whether the concept of the “ecologically noble savage” is a myth. Central to this debate are the problems of how to identify conservationist behavior and the issue of whether sound management practices of common property are likely to evolve. While social scientists have documented instances where restraint over the use of resources occurs, those who adopt an evolutionary perspective are challenged to identify the selective mechanisms whereby such altruistic conservation acts might be maintained in a population. Here a game theoretic approach is used to analyze the case of pastoralist grazing reserves. It is demonstrated that under some conditions, conservation can be the result of narrow self-interest and there is no collective action problem. However, the range of these conditions is much broader for wealthy individuals and thus, the wealthy may also find it advantageous to coerce others into conserving.

INTRODUCTION

Most evolutionary anthropologists define conservation as the costly sacrifice of immediate rewards in return for delayed ones (Hames 1987, Alvard 1995). In contrast, they argue that optimal foragers are those individuals that maximize rates of return while foraging. From this perspective, it would seem that indigenous peoples can be conservationists or optimal foragers but not both, and the balance of evidence indicates that with respect to prey choice at least, the behavior of traditional hunters conforms to the predictions of diet breadth models (Hames 1987, Alvard 1993,1994,1995 see also Stearman 1994, Vickers 1994, Aswani 1998). They’re optimal foragers. In addition, conservation seems theoretically unlikely given that it can be viewed as a form of cooperation and hence is susceptible to problems of free-riding. However, a major simplification was made in contrasting optimal foraging with conservation. Although optimal foraging strategies are those that, by definition, maximize rates of return, in practice, only short-term rates of return are measured. When longer-term rates are considered conservation can be isomorphic with economic efficiency and can thus be the result of self-interested behavior.

The results of this debate are of more than just academic interest. As this audience is fully aware, the relative merits of private, state and/or community management of natural resources is a hotly debated topic (e.g. Pinkerton 1989, Feeny et al. 1990, Baland and Platteau 1996, Hanna et al. 1996, Ostrom et al. 1999). However, the vast majority of studies have concentrated on the problem of how do groups solve the institutional problems associated with free-riding (e.g. McCay and Acheson 1988, Berkes 1989, Ruddle and Johannes 1989, Ostrom 1990) while somewhat fewer have tried to assess how effective are those institutions at conserving resources (Acheson and Wilson 1996). Yet it is equally important to ask how equitable are these systems. In doing so, I also weigh in on a more general argument as to whether heterogeneity hinders or facilitates common pool resource management.

The case presented here is that of Barabaig pastoralists in Eastern Tanzania. A game theoretical approach is used to analyze how wealth asymmetries, in terms of herd size, affect individuals' likelihood of conserving dry season grazing reserves. By incorporating asymmetries in power and interest that typify most human communities, we attempt to add a greater degree of political realism to evolutionary ecological models.

THE BARABAIG

Pastoralists are often depicted as being devastating to the environment; it is thought they keep far too many cows and small stock which devour the landscape (e.g. Lamprey 1983). Yet at other times they are credited with having a conservation ethic, and indeed, much of the evidence for overgrazing is ambiguous (Sandford 1983, Homewood & Rodgers 1991, Ellis & Swift 1988). In fact, it is well documented that most pastoralists have rather complicated rules and regulations regarding what areas can be grazed at any time, who has access to these areas and they have mechanisms for punishing offenders (Netting 1976, Galaty 1994, McCabe 1990, Lane 1996).

To analyze how differences in wealth affect cooperation in managing resources, Monique Borgerhoff Mulder and I chose to model the behavior of Barabaig pastoralists, in part because they are a subset of the Datoga, a group which my co-author has worked with (Borgerhoff Mulder et al. 1989), and because they keep nearby grazing areas as a reserve. This is opposite to most groups but is a situation where we would expect there to be a particularly strong collective action problem. The specifics of the ethnography are drawn from work by Charles Lane (Lane 1996). For our purposes, what is notable is that their permanent settlements are located on the Barabaig Plains near Lake Balangda Lelu, a source of permanent water. During the rainy season they take their cattle further to the west, up an escarpment to the Basoto plains. Water is only available in this area for a limited time after the rains and thus, during the dry season they bring the livestock back to the Barabaig plains near their villages. If there is not enough grass near the villages to last the dry season, they are forced to bring their cattle to the south to an area of woodland greatly infested with tsetse flies.

A MODEL OF COOPERATION WITH WEALTH ASYMMETRIES

A game theoretical approach is used to analyze the strategic and interdependent decisions of Barabaig herders. Beginning with a two person game, we imagine that there are two herders, one rich and one poor. The poor herder owns few (f) cows while the rich herder owns many (m) cows. All cows eat the same amount (α) per day. In turn, there are two kinds of pastures, the wet season plains (WSP) and the near-by dry season reserve (DSR). The wet-season plains are available for a limited number of days each year (d). A cost (C) is incurred for moving the livestock there. The dry season reserve is of fixed size and thus has a fixed amount of grass available (A). Finally, herders have two strategies, they can cooperate and move cattle to the WSP during the rainy season or they can defect by not doing so.

	Rich Cooperates	Rich Defects
	amd + A*m/(f+m) - C	amd + (A - amd)*m/(f +m)
Poor Cooperates	afd + A*f/(f+m) - C	afd + (A - amd)*f/(f+m) - C
	amd + (A - afd)*m/(f+m) - C	A*m/? f+m)
Poor Defects	afd + (A - afd)*f/(f+m)	A*f/(f+m)

Figure 1. Payoff matrix for a game between two herders, one rich and one poor. Payoffs to the poor herder are in the lower left corner of each cell while payoffs to the rich herder are in the upper right.

The payoff matrix (Figure 1) summarizes the payoff to each strategy dependent on the behavior of the other player. During the wet season, each player gets an amount αd for each of their cows (f or m). If one or both players defect and do not go to the wet season pasture, their cows each remove an amount αd from the DSR before the start of the dry season. Thus, during the dry season, each gets a share of however much grass remains in the DSR at the start of the dry season with that share being proportional to the number of cows they own relative to the combined village herd. Finally, players who do move their cattle to the WSP have an amount C subtracted.

We can see then that if a rich herder cooperates, a poor herder should also cooperate if;

$$(\alpha fd) * f/(f+m) > C. \quad (1)$$

In other words, a poor herder should cooperate if the cost of going to the WSP is less than the amount they lose during the dry-season, because they themselves ‘stole’ it.

If a rich herder defects, then a poor herder should cooperate when;

$$\alpha fd - C > (\alpha md) * f/(f+m). \quad (2)$$

That is, when the amount taken from a distant pasture minus the cost of going there, is greater than what would have been the poor individual’s share of what the rich herder is taking from the nearby pasture while the poor individual is away.

If we consider how a rich herder should act when faced with a cooperating or defecting poor herder, we find that the rich individual should base his or her decision on the same criteria. However the asymmetrical payoffs, resulting from differing numbers of livestock owned by the two parties, lead to there being different cutoff points for the two individuals. A defecting herder with few livestock takes less forage from nearby pastures than does a rich defector but the rich herder would normally get a larger share of that “stolen” forage. Thus, given the same parameters, rich and poor’s preferred strategies may not be the same (for more details of the model see Ruttan and Borgerhoff Mulder 1999).

Plotting each player’s indifference curve we see three ESS spaces (Figure 2). Above both curves the ESS is “Mutual Defection”, both poor and rich should defect. Below both curves it is to the advantage of both parties to cooperate and there is no temptation to defect. The ESS is thus " Mutual Cooperation". In the regions between the curves, the ESS is "Rich Cooperate Poor Defect" (RCPD), the herder with more animals should always cooperate while the herder with fewer should always defect. The pattern remains similar as the wet season lengthens (Borgerhoff Mulder and Ruttan 2000) and when the cost of moving to the WSP is assessed on a per animal rather than per herder basis (not shown).

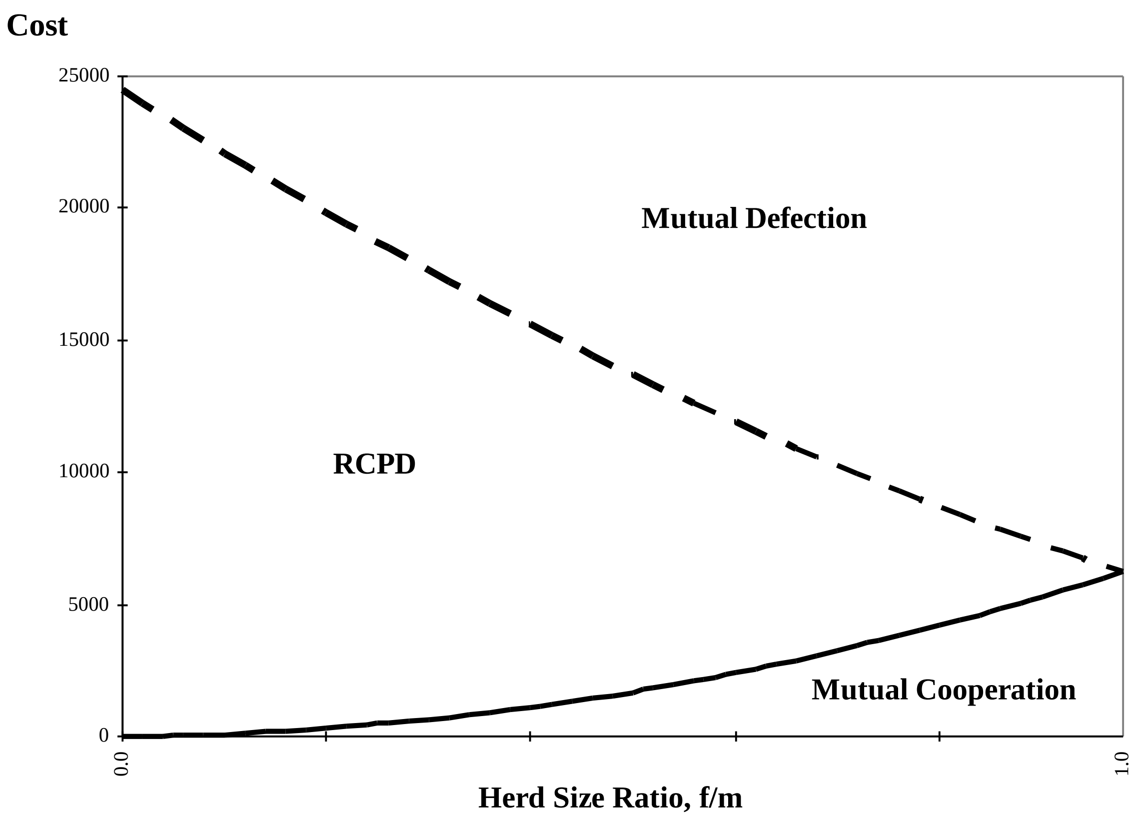

Figure 2. ESS regions for a 2-person game. Equations 1 (dashed curve) and 2 (solid curve) are plotted as a function of cost of moving to the WSP and the ratio of numbers of cattle owned by poor (f) or rich (m). Units of forage eaten per cattle per day, a, is set equal to 1 and the number of days the WSP is available, d = 250.

Three clear patterns emerge, all of which make intuitive sense and suggest that the model captures some important features of grazing patterns among groups like the Barabaig. First, "Cooperation" by either herder is precluded when the cost of using the WSP is very high (perhaps these seasonally available pastures are very remote or perhaps construction and defense of the wet season camps is too labor-intensive, see Sperling and Galaty 1990, Borgerhoff Mulder & Sellen 1994); this is particularly the case when the WSP is only available for a short time. Second, "Mutual Cooperation" is most likely when costs are low and wealth inequalities are mild, that is when the payoffs to any given strategy are different for wealthy and poor herders. Third, "RCPD" (unilateral cooperation on the part of the rich and unilateral defection on the part of the poor) is most common when the costs of using the WSP are moderately high and the inequalities in wealth are sharp, in other words when only some individuals are in a position to benefit from the WSP. Note that this outcome reflects the fact that if a poor herder defects, it still pays a rich herder to leave for the WSP because the value of what a poor herder (with his very few cattle) steals from the DSR in the rainy season does not match what the rich herder (with his many cattle) stands to gain at the WSP.

A MODEL INCLUDING COERCION

Where would the Barabaig grazing patterns fall if mapped onto Figure 2? We know that the Barabaig fine individuals who do not respect the dry-season reserves. If conservation was always consistent with individual preferences there would be no need for fines and thus we can rule out a situation of "Mutual Cooperation". We can imagine two cases where fines might be needed. The first is if the region of "Mutual Defection" is in fact masking a prisoner's dilemma and the second is if there is coercion going on. When the rankings of payoffs are examined in more detail it is found that there is a small area within the "Mutual Defection" region where prisoner's dilemma conditions occur - that is, where cooperation would actually be preferable to defection (Ruttan and Borgerhoff Mulder 1999). This area is found when costs of moving to the WSP are moderate but wealth asymmetries are strong. However, we also wondered whether coercion of the poor by the rich is occurring since in a large part of the RCPD region, the rich would be better off if the poor also chose to cooperate.

In a second version of the model, which is based on a earlier work by Clutton-Brock and Parker (1995), we iterate the game for **N** rounds. As before, rich and poor herders have two choices of strategy but now, the rich herder may cooperate and punish, or cooperate and not punish. (We ignore the choice of defecting since we are restricting ourselves to considering a game played under those parameter values that led to a RCPD in the first place, and thus, defect is not an option for the rich.) If the rich herder chooses to punish, a fine of **p** is imposed on the poor herder while the rich herder receives **p-i**, where **i** is the cost of imposing this fine. The poor herder has the choice of continuing to defect, or of cooperating conditionally, that is only cooperating after having been punished for defecting. A conditional cooperator experiences punishment for **j** rounds before deciding to cooperate in the remaining **k = N - j** rounds. The payoff matrix for this second game is presented in Figure 3.

	Rich Cooperate & Punish	Rich Cooperate & Not Punish
	j{[amd + (A - afd)*m/(f+m) - C] + t - i} + k[amd + A*m/(f+m) - C]	amd + (A - afd)*m/(f+m) - C]
Poor Cooperates	j{[? afd + (A - afd)*f/(f+m)] - t} + k[afd + A*f/(f+m) - C]	afd + (A - afd)*f/(f+m)]
	N{[amd + (A - afd)*m/(f+m) - C] + t - I}	amd + (A - afd)*m/(f+m) - C]
Poor Defects	N{[afd + (A - afd)*f/(f+m)] - t}	afd + (A - afd)*f/(f+m)]

Figure 3. Payoff matrix for a game between two herders, one rich and one poor, where the rich herder has the choice of cooperating and punishing or cooperating and not punishing. The poor herder can either defect or cooperate conditionally. Payoffs to the poor herder are in the lower left corner of each cell while payoffs to the rich herder are in the upper right.

The results indicate that the poor herder should prefer conditional cooperation over defection when the fine is greater than the difference between the cost of going to the WSP and the amount they could have “stolen” from the DSR had they defected. So, when moving to the WSP is costly the punishment would have to be very large to induce the poor to move. In turn, the rich should cooperate and punish when **p > i**. However, if the cost of punishing is greater than the return, the fine, it may still be worth punishing if the rich herder's share of what the poor is "stealing' by not going to the WSP is large. The latter would be the case when the poor's herd size is relatively large. Note that if there are more than one rich punishers there still may be a second-order problem of cooperation. Finally, although this is a 2 person game, it also suggests what might happen if there are few rich and many poor.

DISCUSSION

The second model indicates that conservation can occur when a poor individual is coerced into doing so by a rich individual. We know that in the case of the Barabaig, the existence of fines suggests that at least for some herders, perhaps only in some years, defection is the preferred strategy. As noted earlier, it is not clear whether what we observe reflects a prisoner's dilemma, or an "RCPD" situation in which the rich coerce the poor to cooperate. Ethnography suggests that coercion could be profitable. Among pastoralists generally, herd owners who benefit most from conservation of the dry season reserves (men with the largest herds) are commonly those who are the most powerful in their local community, as elders. Though wealth is not a prerequisite to elder status, influential and respected elders are usually rich in livestock (Borgerhoff Mulder pers. comm.). Furthermore, numerous ethnographic references point to the role of elders in enforcing grazing regulations and policing infractions through committees and moots (e.g. Lane 1990, see also Borgerhoff Mulder 1991). As the analysis indicates, the rich might benefit from punishing herders who utilize the DSR in the wet season, at least if the marginal returns from coercion are positive.

Although the model does not explicitly consider incentives for punishment in an n-person game with more than one possible punisher, there are reasons for thinking coercion is possible and likely. First, the costs of detecting cheaters are small; given the proximity of the DSR to the permanent homesteads of the Barabaig, cattle cannot be grazed there illegally in the wet season without being spotted. Second, the opportunity costs of bringing offenders to trial may be low given that men with one or more wives and grown sons are not directly involved in the day-to-day herding of their stock. In the Datoga, wealthier men do indeed have more people living in their homestead (Sieff 1995); furthermore wealthy pastoralists enjoy more leisure (Fratkin & Smith

1994). It therefore seems plausible that wealthy old men incur few opportunity costs from sitting on committees and councils, attending trials, and adjudicating moots. Third, when offenders are punished a fine is exacted. Among the Datoga and many other groups, disputes can be resolved with fines of cattle, or with obligations to brew honey beer. In either case, the payment is consumed by the elders on the relevant council(s) (Klima 1965), often immediately after the ruling is reached; this is so even in disputes where women adjudicate (Klima 1964). Finally in the Barabaig (Lane 1996) and several other groups it is reported that some councils operate in total secrecy, so as to protect members from the possible retribution of those that are punished. Each of these considerations serves to reduce the costs associated with punishment and regulation.

CONCLUSIONS

Two general conclusions can be made. Firstly, that conservation can be an outcome of individuals attempting to increase their own economic returns, or efficiency. Secondly, asymmetries in payoffs provide the opportunity for unilateral cooperation and/or coercion of the weak by the powerful. These results provide support for the argument that when even moderately long time scales are considered, conservation can be an individually advantageous foraging strategy. It's also notable that mutual cooperation is most likely when heterogeneity is low.

At the same time, coercion may also be more prevalent than suspected. As the costs of conservation and the degree of asymmetry in payoffs increases, opportunities for unilateral (if not mutual) conservation can emerge. If, in addition, asymmetries in payoffs map onto asymmetries in power, dominant individuals may coerce all individuals into cooperating. Under these conditions, heterogeneity may facilitate rather than hinder conservation.

Two points should be emphasized in conclusion. First, it must be realized that this particular case has it's own peculiarities and differences from other pastoral systems, let alone other types of resources. Baland and Platteau (1999) argue that whether heterogeneity has positive or negative effects on the conservation of resources depends on that nature of the resource (and presumably the technology used to exploit it). Their analysis indicates that inequity will favor conservation when a limited amount of free-riding can be tolerated but it will lead to ruin when universal cooperation is essential for the sustained use of the resource. The results presented here fit well with their theory in that a limited amount of free-riding can be tolerated and thus heterogeneity should facilitate community management.

The second point worth stressing is that the implications of the present study do not mean that we sanction the old-fashioned view that the poor stand in the way of conservation. In fact our motivation is exactly the opposite. Given the current popularity of communal resource management systems among Non-Governmental Organizations, we suspect that such projects need to be closely scrutinized, to see not only *whether* they afford biodiversity protection, but *how and why* they work, and potentially in *whose* best interests.

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