Staff Paper

The Economics of Private Voluntary Organizations and Collective Action in Deer Management

by Karin Steffens and A. Allan Schmid

Staff Paper 96-12 March 1996

Department of Agricultural Economics
MICHIGAN STATE UNIVERSITY
East Lansing, Michigan 48824

THE ECONOMICS OF PRIVATE VOLUNTARY ORGANIZATIONS AND COLLECTIVE ACTION IN DEER MANAGEMENT

by

Karin Steffens (email steffens@ pilot.msu.edu)
and
A. Allan Schmid (email schmid@pilot.msu.edu)

March 1996

THE ECONOMICS OF PRIVATE VOLUNTARY ORGANIZATIONS AND COLLECTIVE ACTION IN DEER MANAGEMENT

Abstract

Game theory and other approaches have been used to characterize problems involving high-exclusion-cost goods which also have the characteristic that marginal cost of an additional user is zero over some range. These analytical tools have made valuable contributions to understanding voluntary organizations and collective action. Resource systems for which composition or scale of the resource is an important factor do not fit neatly into the types of problems which are typically analyzed. The Quality Deer Management Association (QDMA) in Southern Wisconsin is used as an example to illustrate where the existing literature must be modified to take account of particular features of this resource problem. Schelling's multi-person prisoner's dilemma model is modified to incorporate preferences and marginal benefits of deer quality to different types of hunters and to explore issues of resource sustainability. Against the odds, the private QDMA has successfully organized hunters to practice harvesting techniques consistent with improved herd quality.

I. INTRODUCTION

The assumption that individuals are motivated by self-interest yields satisfactory results when applied to some goods while analyses of other goods provision and allocation are more problematic. Attempts have been made to use the self-interest assumption to explain why voluntary organizations form to provide goods which are characterized by high exclusion costs and marginal cost of an additional user being zero over some range.

These approaches and alternatives which allow for altruistic behavior are reviewed below. Important contributions have been made to understanding collective action in a variety of settings. However, they do not adequately model collective action to provide a high-exclusion-cost good where the quality of the resource changes. The private voluntary Quality Deer Management Association (QDMA) in Southern Wisconsin will be used as an example for this type of collective action problem. The case will be modeled and its applicability tested with alternative examples.

A. Background

The Quality Deer Management Association formed approximately five years ago in Southern Wisconsin in order to change the composition and size of deer herds. To achieve this result requires a change in deer harvesting. The Department of Natural Resources could change the hunting regulations which apply throughout the State of Wisconsin or voluntary group action could lead to changes in hunting practices. The options will be contrasted below.

For trophy hunters, the deer herds in Southern Wisconsin contain too few mature bucks and too many does and small bucks (Wallenfang 1995). The QDMA tries to produce larger bucks

by changing hunters' harvesting patterns.[1] QDMA members agree not to shoot bucks whose antlers do not extend beyond the deer's ear tips. In contrast, DNR regulations specify that a legal buck is any "deer with an antler 3 inches or more in length" (DNR 1995, 28).

The Association is the result of very modest beginnings. A family in Dane County, Wisconsin, and relatives began the shift in hunting behavior by passing up one-and-a-half year old bucks in order to have some of them grow up to become mature bucks. Next they invited neighbors and friends to participate and then others (Sutter 1995b).

B. The Problem

The deer herd has a number of characteristics affecting the interdependence of the parties involved. It is not feasible for an individual to fence an area, invest in deer management, and then keep the benefits to him/herself. Property lines do not follow habitat requirements as the deer move about in partly predictable, partly random patterns. While individual effects on the entire deer herd are negligible, incompatibility exists for individual deer. The high exclusion cost of the benefits of system management and high subtractability of resource units make this problem a common pool resource (Ostrom 1994, Ostrom 1990).

Since the resource system is large, individual management efforts will have a negligible effect on the quality of the resource. Unless a threshold number of individuals coordinate their efforts, there is no improvement in hunting quality. Foregoing one buck has no perceptible effect

[1]The QDMA is not only interested in changing the composition of the deer herd but also in reducing the overall size of the herd by encouraging members to shoot more antlerless deer. This particular aspect of QDMA is not emphasized in this paper.

on the buck-doe ratio. The individual has no incentive to engage in management efforts since individual benefits are negative until the threshold is reached.

If enough hunters forego small bucks, more bucks will grow up to become mature adults. Most hunters are trophy hunters[2] and when a large buck cannot be had, shooting a small buck is considered more prestigious than a doe or fawn (Wallenfang 1995). The incentives are such that the individual has more to gain from not cooperating in the management effort than from cooperating, which constitutes a prisoner's dilemma. The question arises how to assemble a group of cooperators, large enough to affect herd composition, and how to sustain the desirable outcome. Game theory and approaches that allow for altruistic human behavior model collective action problems and formation of private voluntary organizations. They will be discussed below.

II. VOLUNTARY ORGANIZATIONS AND COLLECTIVE ACTION

A. The Literature

1. Game Theory

Game theory tells us that uncoordinated actions by rational and self-interested individuals do not necessarily lead to aggregate outcomes with the highest possible payoffs to the individuals (Dawes et al. 1990). The equilibrium outcome in a basic prisoner's dilemma game, where neither player cooperates, leaves the players worse off than if they had cooperated, but cooperation is nevertheless elusive.

In deer management, this translates into most hunters shooting small bucks because the cooperative outcome of foregoing them in order to have larger bucks in the future is not in the

[2]Meat hunters are more likely to shoot antlerless deer and are not considered here.

individual's self interest. The non-cooperator who shoots small bucks is always better off, regardless of the action of others.

Sophisticated versions of the basic prisoner's dilemma game can lead to cooperation among players and maximum payoffs to the individuals. One such setting involves an infinitely repeated game with a trigger strategy of cooperating until someone no longer cooperates (Gibbons 1992). Complete information is a prerequisite for the cooperative outcome. This setting may be approximated by a close-knit and stable community of hunters. Finitely repeated games of complete information do not lead to cooperative outcomes, however. Allowing for two-sided asymmetric information in a two-person prisoner's dilemma may produce cooperation (except for the last stages of the game) when tit-for-tat is a possible strategy with positive probability (ibid).

An extension of the game-theoretic approach is Schelling's multi-person prisoner's dilemma (Schelling 1978). The games are structured such that individuals who choose the cooperative choice, no small bucks, will have negative payoffs until a minimum number cooperate. Then the payoffs are positive because there are more larger bucks.

The degree to which non-cooperators are better off than cooperators can vary across games and over the range of cooperators (ibid). The number of cooperators necessary for positive payoffs to cooperators (minimum coalition) becomes a critical variable. The difference between payoffs from cooperating and not cooperating is also of significance as it determines the incentive for not cooperating. Differential payoffs may increase or decrease as more individuals cooperate.

2. Other Approaches

While game theory focuses on individuals' self interest, Robert Frank (1988) finds a role for emotion as a way to solve the commitment problem characteristic of prisoner's dilemma and other situations. In the long run, people who are known to behave altruistically are sought out as partners by others and will seek out equally motivated individuals. For example, the QDMA may invite individuals to join the association who are known to have cooperated in similar situations. This allows them to reach superior outcomes to the equilibrium of the prisoner's dilemma.

Elinor Ostrom (1990) describes group formation criteria for situations where potential members of a collective action group cannot be chosen at random. In the case of QDMA, if a region were to be set up for quality deer management, it would be desirable to have all or most landowners in the area participate. Ostrom (1990) tentatively establishes seven rules for enduring self-organized groups. Monitoring and graduated sanctions are prominent among them. Hunters like to have their trophies admired by other hunters. In communities where friends and neighbors are part of a hunter's social group, it is easy to monitor whether a group member deviated from the agreed-upon rules. Graduated sanctions become operative in the form of social pressure to cooperate, which varies from case to case. Younger hunters may get away with only mild criticism, but repeated violation of the rules for long-time (successful) hunters may lead to severe pressure, perhaps social ostracism (Steffens 1995).

Mancur Olson (1965) asserts that collective action to obtain a high-exclusion-cost good will not occur freely in a large group of self-interested individuals. Coercion or some selective incentive distinct from the high-exclusion-cost good is necessary to get individuals to join a large organization to provide the good. The QDMA provides valuable information and a forum for

social interaction as incentives to join (Sutter 1995a). Smaller group size, homogeneity of individual interests, and social capital will make voluntary collective action more likely when coercion and external incentives are absent (ibid; see also Schmid 1987 and Hayami and Ruttan 1985).

Dawes et al. (1990) conducted experiments testing the hypothesis that group identity, as established through communication among members, enhances cooperation. They find considerable support for the hypothesis. QDMA meetings and the fact that many hunters know each other as friends and neighbors should therefore facilitate cooperation. Past experiences with cooperation may also explain voluntary group formation for collective action. Past experience can build trust which can then at a later date carry over to other, even more complicated and very different settings (Hirschman 1984). This does not, however, explain how initial trust was established.

Collective action and formation of private voluntary organizations is a form of institutional change. Hayami and Ruttan (1985) view basic institutions as changing incrementally. The change depends on the cost of achieving social consensus. The initial phase of quality deer management reflects this pattern. The group progressed from small beginnings, including only the family then neighbors and friends, to a later stage where other individuals were involved as well.

B. Quality Deer Management Association: Special Case or Model

1. What Makes QDMA Different?

Many of the features identified in the various approaches to collective action and voluntary organization as described in II A can be applied to the Quality Deer Management

Association. The literature captures some of the features of QDMA but not others. Group formation to solve the type of problem discussed here may be explained by approaches listed above (see Steffens 1995 on QDMA as a common-pool resource) . The general setting of the deer management problem corresponds to a multi-person prisoner's dilemma (Schelling 1978). There are some special features, however, which will be explained in this section.

Figure 1 shows the level of average payoffs on the vertical axis. Average, rather than actual individual payoffs, are used because there is always some chance of shooting a large buck. The average is then calculated based on the probability of shooting a large buck and an antlerless deer for cooperators and the probability of shooting a large buck and a small buck for non-cooperators.

On the horizontal axis from left to right is the number of cooperating hunters not shooting small bucks, n is the total number of hunters in the resource system, and n minus the number of cooperators is the number of non-cooperating hunters, those willing to shoot small bucks. Curve C is the expected payoff to a cooperator as a function of the number of cooperating hunters. The minimum coalition required for cooperators to break even is k. The curve NC is the level of expected payoff to the non-cooperator as a function of the number of others who cooperate.

At low levels of cooperation, average payoffs to cooperators are negative as there are practically no large bucks to hunt and they forego the utility of shooting small bucks and only shoot antlerless deer which afford them no status with other hunters. Non-cooperators also have little chance of shooting a large buck but are willing to shoot small bucks from which they derive some satisfaction. Their average payoff is slightly positive.

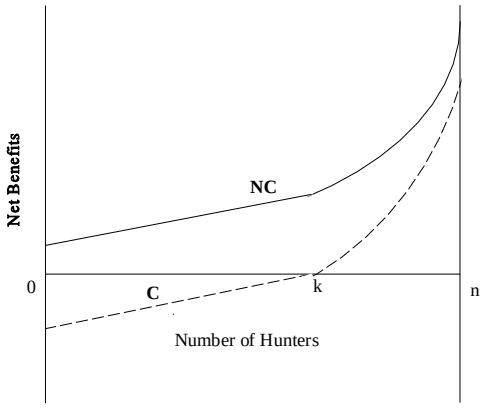

Figure 3:Payoffs As A Function Of Number Of Cooperators

As more and more hunters forego small bucks, the probability of shooting a large buck increases for all and both curves show a slight upward trend toward k. To the right of k the number of large bucks becomes significant and average payoffs for cooperators become positive. At this point the two curves turn up sharply, reflecting the fact that significantly more large bucks are shot by all. Additionally, as more hunters become cooperators, they shoot more antlerless deer as a group, contributing to the reduction in herd size which improves habitat. This allows bucks to grow bigger antlers.

When more large bucks are sighted before deer season hunters, cooperators and non-cooperators, will then have the incentive to hold out for a bigger buck. Mature bucks are more difficult to hunt because they tend to be more wary than small bucks and they often feed after dark when hunting is illegal. Since large bucks are highly preferred by most hunters, small bucks will very likely be passed up for the opportunity to hunt a mature buck, especially if one has been spotted in the area. This behavior can move all hunters farther to the right of figure 1 where average payoffs to all are higher.

At n, the point where everyone in the management area is cooperating, the two curves are shown to be fairly close together with NC slightly higher than C. No one is shooting small bucks. This may be because of true cooperation, shooting of antlerless deer rather than small bucks, or because there are enough large bucks for everyone to hunt one. If the curves were touching, the average payoffs would be identical. However, for someone who cannot get a large buck, there is still the incentive to shoot a small buck for the non-cooperator while a cooperator would forego a small buck. Therefore the two curves are not drawn with identical payoffs at n.

Figure 1 shows average payoffs at any point in time. It is possible, however, that as time goes by and the QDMA recruits more and more members, changes in hunting ethics develop and the two curves begin closer together at the origin. Currently, the predominant hunting ethic is not to shoot does and fawns (Steffens 1995). Learning reduces the prisoner's dilemma. QDMA has been successful in achieving more than the minimum coalition. This success is consistent with a model where social factors work to achieve the minimum coalition and then the payoffs of cooperator and non-cooperator converge as more people cooperate.

The desired outcome, a more balanced deer herd with more mature bucks, may be sustained without anyone choosing the non-cooperative option. This will depend on how successful hunters are in shooting a trophy and which option is chosen by unsuccessful trophy hunters. If the latter hold out for a big buck until the end of the season, they will not shoot a deer. If they do not hold out until the end of the season, they may opt for an antlerless deer or a small buck. If not too many choose the small buck option, the desired composition of the deer herd can be sustained over time from season to season without some hunters having to choose the

cooperative option. Whether a hunter is successful in bagging a trophy depends on the number of hunters, the density of mature bucks in the hunting area, the skill of the hunter, and some luck.

Changes in DNR hunting regulations and license fees can significantly affect QDMA management efforts as can changes in meat hunting activities and random effects due to weather and climate.

3. Alternatives to QDMA

The DNR can provide alternatives to the QDMA. Currently a legal buck is defined as a "deer with an antler 3 inches or more in length" (DNR 1995, 28). If this definition were changed to: a deer with an antler spread that extends beyond the ear tips, only larger bucks could be taken legally. This rule could have the same outcome as QDMA. The difference lies in the flexibility which the QDMA allows; hunters are not forced to join the QDMA and would not be violating any laws by shooting smaller bucks. A DNR survey revealed that hunters are interested in big-buck management but are opposed to tougher DNR regulations (Wallenfang 1995). Enforcement could also be a problem if hunters have difficulties estimating antler size correctly.

The DNR could also institute a lottery system by which a limited number of buck tags are allocated to hunters who apply for them. Many hunters are opposed to this type of deer herd management also. The QDMA allows those hunters who have very strong preferences for bucks to shoot a buck, even if it turns out to be a small one, while those who have strong preferences for big bucks but a significantly lower preference for small bucks forego less by shooting antlerless deer.

4. Applicability of the Model

Fisheries and the problem of over-fishing is a candidate for applying this analytic approach. While fisheries share a lot of characteristics with deer herds, high exclusion costs, marginal cost of an additional user being zero over some range, a highly mobile resource, composition of the fish catch is generally not a significant factor in fishing.

This is not true, however, in the shrimp industry, where large shrimp are sold at a premium and therefore are more desirable (Johnson and Libecap 1982). Cooperative and non-cooperative strategies here are foregoing small shrimp and not foregoing small shrimp, respectively. A significant number of large shrimp do not become available until a minimum number of shrimpers have foregone small shrimp.

Recycling also provides an example for using the approach described above. In this case a minimum coalition of individuals who recycle is necessary in order to provide incentives for industries (and technology perhaps) to develop that use recyclables as an input into their production process. If the scale of recycling is large enough and production costs low enough, a market for recyclables will develop to provide incentives to sell recyclables.

Thus, while the QDMA may look like a special case at first glance, similar problems exist to which this approach incorporating quality change can be applied.

III. SUMMARY AND CONCLUSIONS

Goods which are characterized by high exclusion costs and marginal costs of an additional user being zero have been analyzed in the literature using a variety of approaches. While game theory, induced innovation, common-pool resources, and other analytical tools mentioned in this

paper have valuable contributions to make toward explaining the formation of voluntary organizations and collective action, quality deer management serves as an example of a problem which has features not adequately addressed by the existing literature.

Deer management combines a set of special features. Quality of the resource is an important variable. A social dynamic is necessary to achieve a minimum number of individuals choosing the cooperative option in order to significantly affect herd composition. Positive average payoffs to cooperators set in when the utility of the increased chance of shooting a large buck outweighs the disutility of foregoing a small buck. As the number of large bucks and average antler size increase, the payoff curves move closer together as the sacrifice required of cooperators is less.

There is a temporal dimension to the case which is hard to model formally. When the number of large bucks grows due to the forbearance of the earlier cooperators, both cooperator and earlier non-cooperator can harvest the high-exclusion-cost good (big buck). The utility of the hunt increases with the probability of shooting a big buck and the cost of foregoing small ones declines. Sustainability of the improved outcome is path dependent and once a positive payoff to cooperation is achieved, the payoff curves accelerate and the gap between the curves narrows, as the demands on altruism and other social dynamics decrease. Narrow calculation of advantage is potentially sufficient to maintain the long-run sustainability of the system if the higher probability of shooting large bucks does not lead to significantly increased hunting pressure. The unexpected success of QDMA is consistent with this model and a sustainable outcome.

BIBLIOGRAPHY

Dawes, R., A.J.C. van de Kragt, and J.M. Orbell. "Cooperation for the Benefit of Us - Not Me, or My Conscience." *Beyond Self Interest*. Mansbridge, J. ed. 1990.

Department of Natural Resources (DNR). 1995. 1995 Wisconsin Hunting Regulations.

Frank, R.H. *Passions Within Reason. The Strategic Role of the Emotions*. W.W. Norton & Company. 1988.

Gibbons, R. *Game Theory for Applied Economists*. Princeton University Press. 1992.

Hayami Y. and V.W. Ruttan. *Agricultural Development. An International Perspective*. Chapter 4: "Toward a Theory of Induced Institutional Innovation". Johns Hopkins University Press. 1985.

Hirschman, A.O. *Getting Ahead Collectively: Grassroots Experiences in Latin America*. Pergamon Press. 1984.

Johnson, R.N., and G.D. Libecap. "Contracting Problems and Regulation: The Case of the Fishery." *Amer. Econ.Rev.* (December 1982): 1005-22.

Olson, M. Jr. *The Logic of Collective Action*. Harvard University Press. 1965.

Ostrom, E. *Governing the Commons. The Evolution of Institutions for Collective Action*. Cambridge University Press. 1990.

Ostrom, E., R. Gardner, J. Walker. *Rules, Games, and Common Pool Resources*. University of Michigan Press. 1994.

Schmid, A. *Property, Power, & Public Choice. An Inquiry into Law and Economics*. Praeger Publishers. 1987.

Schelling, T. *Micromotives and Macrobehavior*. Norton. 1978.

Steffens, K. "The Quality Deer Management Association. Analysis of a Common Pool Resource." Michigan State University Staffpaper No. 95-49. 1995.

Sutter, Greer. Co-founder of the Quality Deer Management Association. Personal Communication. March 1995a.

___. Co-founder of the Quality Deer Management Association. Personal Communication. May 1995b.

Wallenfang, K. Department of Natural Resources, Fisheries and Wildlife. Personal Communication. April 1995.