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2008

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How to cite

DI FALCO, Salvatore, VAN RENSBURG, Thomas M. Making the commons work: conservation and cooperation in Ireland. In: Land Economics, 2008, vol. 84, n° 4, p. 620–634. doi: 10.3368/le.84.4.620

This publication URL: <https://archive-ouverte.unige.ch/unige:42234>

Publication DOI: [10.3368/le.84.4.620](https://doi.org/10.3368/le.84.4.620)

Making the Commons Work: Conservation and Cooperation in Ireland

Salvatore Di Falco and Thomas M. van Rensburg

ABSTRACT. *Commonage represents land held under common property that incorporates a system of local cooperative arrangements and rules to conserve and manage the Irish uplands. We analyze the institutional and economic factors that influence the behavior of commonage farmers under a common property regime using a recursive bivariate probit model. Results show that (1) cooperation has a positive and important impact on commonage conservation; (2) agricultural policies by way of livestock premia increase the level of degradation; while (3) farm financial support through agri-environment measures positively affects commonage conservation and encourages cooperation between farmers. (JEL Q24, Q15)*

I. INTRODUCTION

There is a significant literature indicating that communal groups can develop institutions to manage natural resources in a manner which is consistent with their conservation (Ostrom 1990; Bromley 1992; Baland and Platteau 1996; Feeny, Hanna, and McEnvoy 1996; Hegan, Hauer, and Luckert 2003). A key determinant of the success of common property resources (CPR) is thought to be the group's ability to cooperate and a number of studies have enriched our understanding of the factors and processes which produce collective outcomes (Wade 1987; Ostrom 1990; Baland and Platteau 1996; Bromley 1998; Gebremedhin, Pender, and Tesfay 2004).

Interest in cooperative management of CPRs has been stirred by globally pervasive concerns about environmental degradation, and by difficulties in establishing private property rights over natural resources, especially in developing countries. It is also

thought that communal property rights may encourage greater "conservation effort" particularly if resource users are directly dependent on the ecological services provided by natural resources (Runge 1986; Ostrom 1990; Baland and Platteau 1997, 1998). Failures attributed to management by the state or the private sector have made collective action attractive to many policymakers as a means of managing grazing, forest, and fisheries, with many governments decentralizing environmental management and promoting community-based conservation initiatives (Li 1996; Heltberg 2001; Giertsen and Barrett 2004).

However, despite the significant literature on CPRs, studies which empirically test for the effectiveness of cooperation on resource conservation are rare (de Janvry, McCarthy, and Sadoulet 1998; McCarthy, Sadoulet, and de Janvry 2001). We found only three empirical studies demonstrating that cooperation has a positive measurable impact on land fertility or stocking rates (Ahuja 1998; Lopez 1998; McCarthy, Sadoulet, and de Janvry 2001) and two that indicated that cooperation had a negative effect on conservation (Stevenson 1991; Lopez 1993).

This paper seeks to add to this empirical literature by presenting an analysis based on a common grazing resource in Ireland,

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the Irish Commonage. Irish Commonage represents an outstanding example of land held under common property embodying a system of rules and cooperative arrangements to manage extensive areas of upland grazing. Access to grazing is restricted to members of the commonage and therefore avoids the tragedy of the commons which typifies resource use under open access.¹ Although shareholders have distinct undivided shares they cannot exclude co-shareholders. Individual decisions to control stock numbers do not give a farmer exclusive rights over the benefits of his/her actions and consequently many commonages have been overgrazed (Bleasdale 1995; Bleasdale and Sheehy-Skeffington 1995; Emerson and Gillmor 1999). To avoid overgrazing, farmers have developed a system of cooperative arrangements to restrict individual effort (i.e., to restrict grazing intensity by individual shareholders) and thereby conserve the commonage grazing resource. It is important to note that the majority of studies on collective action are located in developing countries and a substantial number of these papers emphasize the dependency of farm households upon the services provided by CPRs which are seen as crucial in supporting rural livelihoods. Our study provides empirical evidence that serves as a reminder that CPRs in developed countries, far from being redundant, still play a vital role in managing environmental quality and in sustaining rural communities despite the presence of well-defined markets, agri-environmental policies, and other forms of

intervention that provide a safety net for the farming community.

This study has three main aims: first, to determine if the cooperative management of commonage favors its conservation; second, to investigate whether agri-environment schemes such as the Rural Environment Protection Scheme (REPS) support conservation and/or cooperation; third, to evaluate the impact of livestock premia² on conservation and/or cooperation; and fourth, to investigate the relationship between cooperation and shareholder dependence on commonage. Conservation and cooperation are jointly determined variables. We, therefore, adopt a simultaneous recursive bivariate probit model. This approach allows us to model cooperation and conservation as a simultaneous equation system where the endogeneity of cooperation can be ignored in formulating the log-likelihood model (Greene 2000). We begin with the consideration that the *i*th member of a given commonage signals their willingness to make an effort towards conservation and the prevention of overgrazing by allocating livestock numbers that are below the average stocking rate for that commonage. Then, we investigate the role of cooperation on commonage activities, as well as a set of other covariates, on the probability of conservation. Rather than use the term restricting individual effort, we employ the term "conservation effort" because it represents an attempt to conserve the resource by restricting grazing intensity by individual shareholders.

The paper proceeds as follows: First, some background is given on commonage. Next, a description of the survey instrument and methodological approach is provided. Then, the empirical strategy used to explore the relationship between cooperation, conservation, and agricultural policy is presented and the results discussed. Final remarks and considerations are offered in the conclusions.

¹ Common property in contrast to open access involves members of a clearly demarcated group which have the legal right to exclude non-members of that group from using a resource (Lyll 2000). Bromley (1991) suggests that common property is in essence, private property for the group of co-owners and in that sense it is a group decision regarding who shall be excluded. Individuals have rights and obligations in situations of common (non-individual) property. According to Ostrom (2000b), "common property" regimes typically involve participants who are proprietors, who have the right of access, right of withdrawal (extraction), right of management and right of exclusion over a resource.

² Premia are defined as the headage premiums payable under the sheep, suckler cow, and beef premium regulations of the European Union.

II. BACKGROUND

Systems of communal tenure involving farming families are known to have occurred throughout Ireland in the form of territorial commons, manorial commons, and the Irish Rundale system,³ which was developed to give small holders access to land and to ensure that villagers complied with village laws as a means of regulating communal grazing, turbary, and foreshore rights (Almquist 1977; Andrews 1987; Kelly 1997; Whelan 1999).

The boundaries of contemporary commonage were created by the Irish Land Commission which was set up by the Irish government and which formally granted grazing rights to Irish tenants with very small holdings during the period of land reform from the end of the nineteenth century until the 1980s⁴ as a form of land distribution to ensure that none remained economically disadvantaged (Lafferty, Commins, and Walsh 1999). Commonage is land held in common ownership on which two or more farmers have grazing rights (Lyll 2000).⁵ Farm households continue to be the main stakeholders of Irish commonage, although other interest groups, particularly recreation and conservation bodies and environmental partnerships, have become more involved in the stewardship and management of commonage in recent years (Phillips and Tubridy 1994; Nugent 1995; O'Keefe 2005; Hynes, Buckley, and van Rensburg 2007).

Importantly, access to a given commonage is restricted to a group of shareholders who have the legal right to exclude non-shareholders, thus creating the potential to avoid the tragedy of the commons so typical of open access. Commonage can thus be thought of as a Common Property Regime (in which shareholders have the legal right to exclude non-shareholders) and not open access. Notwithstanding the right to exclude non-shareholders, difficulties remain in achieving efficient use of a resource due to rivalry between individual shareholders of a given commonage. Each shareholder within a commonage has an equal right to possession of the land held under co-ownership. Therefore no tenant has the right to exclude his/her co-tenants from possession of any part of the land or to prevent them from taking a share in the rents and profits of the land.

Use by an individual shareholder requires decisions as to how much effort to commit to appropriation of the resource as well as to the collective management and to the upkeep of commonage. Effort toward provision may include protecting the commonage from encroachment by non-shareholders, collective stock management, and compliance with grazing and stocking rules, as well as investments in commonage upkeep (hedgerow and stonewall maintenance and drainage).

Commonage as a system of land tenure is very important for Irish agriculture, conservation of the uplands, managing the environment, and for sustaining rural livelihoods. There are an estimated 426,124 hectares of surviving commonage in the Republic of Ireland managed by 11,837 farms (CSO 2002).⁶ There are approximately 4,500 commons in Ireland of which 21% of all Irish farms have a share,

³ The Rundale system involved small holders renting land in common from local landlords. Large expanses of blanket peat bog and mountain land were used jointly by village co-tenants and the system of tenure ensured that most individuals had access to some land.

⁴ Set up as a result of the Land Acts of the late 19th century—1881 and 1891.

⁵ The owners of the grazing rights are legally the commonage shareholders of a given commonage. In Ireland, under Common Law, land held in commonage is seen as a Tenancy in Common, whereby each tenant holds a distinct, separate, and undivided share in the property, although no one person owns any particular part of the property. Farmers are the legal right-holders of commonage and its use for other purposes technically requires the approval of the right-holders.

⁶ The majority of these farms are located in upland areas of the west of the country. Nearly half of all commonages occur in Connacht (5,379) with 2,050 in Galway and 2,416 in Mayo and in these two counties, over 75% of the farms using commonage are below 30 ha in size (CSO 2002). Commonages are normally contiguous areas of land and form distinct parcels which are typically associated with a community in a village or townland.

which makes it a sufficiently significant Irish phenomenon.

Commonage land also plays a crucial role in maintaining rural livelihoods in the west of Ireland. The Rundale system and the Irish Land Commission both upheld access rights to communal grazing land as part of an equitable system of land distribution in view of the marginal nature of agriculture along the western seaboard (Whelan 1999; Lafferty, Commins, and Walsh 1999). Today, most commonage farmers continue to occupy small areas of private land, produce low incomes, utilize marginal land that has a limited range of agricultural uses (predominantly sheep or cattle/sheep enterprises), and depend on extensive areas of commonage to supplement their incomes and thereby have a keen interest in its continued use, upkeep, and conservation.

Cooperation by individual shareholders towards upkeep of commonage also contributes toward a number of collective goods. These include external benefits such as improved biomass and livestock yields for other shareholders in the same commonage. The commonages cover extensive areas occasionally over several thousand hectares. In taking a decision to control stock numbers, a farmer does not gain exclusive rights over the benefits of such an action. Although the farmer does benefit in the form of improved forage quality and livestock offtake from his commonage share, he also provides external benefits by improving livestock yields for other shareholders in the same commonage. Other public goods of conservation or recreational interest are provided. These include reduced soil erosion, improved water quality, enhanced levels of biodiversity and landscape, and outdoor recreation opportunities.

From extensive observation and field research, we know that shareholders do (1) make a "conservation effort" to comply with a system of rules in order to restrict overgrazing, and (2) cooperate in protecting commonages from encroachment by non-shareholders and in the maintenance and improvement of infrastructure (fencing, stonewalls, drainage). However, this is by

no means a universal phenomenon. Although many commonages in Ireland continue to serve an important agricultural role, the nature of this function is undergoing change. Changing demographic patterns in rural Ireland, amalgamation of farm holdings, modernization of farming methods, and state intervention in the form of livestock premia have led to fewer active commonage shareholders and in many instances, a decline in the quality of management of commonages and the level of cooperation between shareholders. In some areas, concentration of commonage control, and the dissolution of traditional institutions have led to commonage degradation and severe overgrazing by livestock (Bleasdale 1995; Bleasdale and Sheehy-Skeffington 1995). The effects of high grazing intensities include: (1) the disappearance of heath and calcareous grasslands; (2) reduced habitat for rare species (e.g., red grouse); (3) decline in grassland productivity due to replacement by less productive grasses; and (4) the loss of peat which has increased water pollution and led to the decline in salmonid species (Bleasdale 1995).

These effects have given rise to concern by the public and by policymakers. In Ireland the solution to commonage management has placed particular emphasis on the reform of CAP payments and the complete decoupling of income support to farmers from price support and towards direct income support and the voluntary participation by shareholders through the introduction of agri-environment schemes.

Agri-environment schemes were evoked as part of the 1992 MacSharry reforms of the CAP (DAFF 1996; Emerson and Gillmor 1999). The broad objective of such reform was the continued integration of environmental goals into agricultural policy and a means of curbing agricultural production and targeting subsidies paid out to land managers more towards public goals of land management rather than private production⁷ (Lowe and Brouwer 2000; CEC

⁷ Agri-environment schemes aim to encourage farmers to adopt environmentally friendly agronomic practices in exchange for financial compensation for environmental practices.

2002; Matthews 2002). These goals include the maintenance of ecological functions—water quality, biodiversity, and promotion of environmental amenities including scenic, cultural, and conservation values for recreation purposes (Bromley and Hodge 1990; Hanley et al. 1998). The main scheme in Ireland is known as the Rural Environmental Protection Scheme (REPS—Regulation 2078/92) which was first introduced by the Irish government in 1994 (Emerson and Gilmour 1999; Brouwer and Lowe 2000). It has since been replaced by REPS 3 which is implemented under regulation 1257/99 following the Agenda 2000 CAP reforms (CEC 1998; DAFF 2004).

REPS 3 (hereafter referred to as REPS) is universally available to all Irish farmers; is voluntary; involves a comprehensive farm management plan (i.e., it is not menu-driven), mandatory training, and includes a tiered system of payments based upon farm size (Emerson and Gilmour 1999; DAFF 2004). Farms in the survey area range in size, but they are predominantly extensive sheep or cattle/sheep farms, provide relatively low-incomes, and involve marginal lands. It is precisely these farmers that the REPS scheme is designed to target.

The specific effects of state intervention—namely livestock premia and agri-environment measures—on the steps taken by individual shareholders to (1) regulate stock numbers and thereby impose a “conservation effort” in accordance with their own rules, and (2) cooperate in grazing management and commonage maintenance, are not known. Empirical work on upland commonages is exclusively confined to ecological studies on overgrazing (Bleasdale 1995; Bleasdale and Sheehy-Skeffington 1995; Douglas 1995). None of these studies consider the effects of these policies directly, nor do they consider the cooperative arrangements used by farmers to manage commonages. Consequently, it is not clear whether these specific regulations threaten Irish commonages and the local institutional arrangements that have developed in order to protect them. The livestock premia schemes and REPs have co-evolved

alongside informal local institutions which can set clear boundaries to restrict access to shareholders who jointly implement grazing management regimes. However, it is still not clear how these government measures affect these institutional arrangements, or what impact they have on the cooperation and joint management of commonage. This makes the study of commonage extremely relevant to the future of Irish agri-environment policy. In what follows, we propose an empirical framework which links commonage conservation with cooperation in the presence of livestock premia and agri-environment measures.

III. DATA, METHODS, AND VARIABLE DESCRIPTION

This study is located in Connemara, County Galway and County Mayo. The population of what is essentially a rural community numbers approximately 283,000 (CSO 2006). The Atlantic climate of Connemara and Mayo gives rise to high levels of precipitation particularly in mountainous regions where 2,500 mm of rainfall per annum is typical (Webb and Scannell 1983). The landscape of southern Connemara is low-lying and composed of large expanses of western blanket bog. The soils of the upland grazing areas are generally of low productivity and are best suited to extensive cattle and sheep production. Very little arable farming occurs in the study areas.

In the spring and summer of 2004 a total of 282 farms were identified as operating management regimes considered typical of commonage farmland. Data were drawn from the official list of Commonage farmers (CSO 2002). The list includes 555 households registered as commonage shareholders actively managing commonage land and using a variety of rules and cooperative arrangements to manage livestock. These farms are also in receipt of farm financial support. All the farms were asked to participate in the survey and 282 agreed to take part in the analysis, thus the response rate was 51%.

TABLE 1
VARIABLE DEFINITIONS

<i>Age</i> : Age of the decisionmaker
<i>Size</i> : Share of land from the commonage
<i>Non-Farm Income</i> : Income from non agricultural activities, in euros
<i>Shareholders</i> : number of shareholders actively using their shares of the commonage
<i>Reps</i> : Payment received under the REPS scheme, in euros
<i>Premia</i> : Payment received for suckler cow, beef, ewes, and bulls, in euros
<i>Labor</i> : Number of hours spent on farm related activities every week
<i>Cost</i> : Total variable cost of the activity, in euros
<i>Cooperation</i> : Cooperation with other shareholders on the management of the commonage (Yes = 1; No = 0)
<i>Conservation effort</i> : No of livestock units per ha of land in the commonage (1 = below the sample average; 0 = above the sample average)
<i>Private</i> : Private land owned by the farmer, in ha.

Personal interviews were undertaken by staff from the National University of Ireland, Galway, with the owner-operator at the owner's property. Each interview lasted approximately 45 minutes and followed a standard format. The questionnaire was piloted for one month during February 2004 and this aided the design of the survey.

Each survey provided detailed data on revenue and cost summaries, farm premia, use of technology, labor, and costs of farm operations, particularly grazing and livestock activities. The survey focused principally on market costs and benefits. Information on shareholder activities and on current and past land management practices were also documented. The range of enterprises on these farms included sheep, beef, and suckler cow production. On most of the farms, livestock are moved from lowland areas surrounding farmsteads to upland commonage areas. Consequently, additional information on shareholder/ grazing rights, number of active shareholders and the movement of livestock was also obtained.

Property rights and the non-excludable nature of commonage are known to affect land management (Ostrom 2000b). Consequently, information on the number of active shareholders, farmer attitudes to commonage, and the nature of decision-making—whether individual or cooperative

management by shareholders—was also sought. Farmers were also questioned about commonage management, its degradation, and their attitudes to its future use.

Table 1 reports the definition of the variables used in the empirical analysis. It refers to the term cooperation. Farmers in the study area cooperate on a variety of agronomic practices including stock management, tending of stock, measures to prevent overgrazing, and on-farm investment decisions in fencing, stone walling, hedge maintenance, and drainage. Using this information, we develop a binary variable to identify whether the farmer cooperates or does not cooperate in the management of the commonage (1 if the household cooperates on at least one of these activities, 0 otherwise). In the sample, we did not find much variation in the set of activities undertaken by the farm. We, therefore, could not control for differences in the quality or typology of cooperation (see de Janvry, McCarthy, and Sadoulet 1998). We found that 36% of respondents reported that they were cooperating toward the management of the commonage.

Table 1 also shows the Conservation variable used in this study. Clearly, finding a measure for conservation can be problematic and different metrics or measures will be appropriate for different tasks. For instance, Lopez (1997) and Ahuja (1998) develop an index for conservation in the form of biomass stock which they use to show that some communities do cooperate in managing the fertility of agricultural land in Cote d'Ivoire. Such a measure is particularly appropriate to capture the relationships between cooperation and system productivity. Extensive field research across commonages in Ireland indicates that livestock stocking rate is the single most important issue affecting upland commonages. A number of studies have repeatedly stressed the need to reduce stocking rates in commonage upland areas (CEC 1993; Bleasdale 1995; Bleasdale and Sheehy-Skeffington 1995; Douglas 1995; Emerson and Gilmour 1999). This explains why recent efforts to conserve commonages have

all focused on persuading farmers to reduce animal numbers. Indeed, phenomena such as overgrazing are considered to be a threat to ecological conservation of rural areas in other parts of Europe (Simpson et al. 1998; Caraveli 2000).

The commonage farming community is well aware of the link between livestock numbers and commonage degradation and it is a crucial management variable which farmers have traditionally regulated using commonage rules. We found that about 70% of respondents reported that they were taking steps towards conservation.

Farmers rely on a system of cooperative arrangements to restrict individual effort. Actions by individual shareholders to restrict stock numbers represent an individual shareholder's actions to conserve the resource in accordance with local rules. We acknowledge that there are a number of other possible reasons why farmers might reduce stocking rates. These include seasonal labor shortages, increases in off-farm income, farmer age, whether the farmer had an obvious heir, and other demands made of the land. This said, we use the term "conservation effort" or simply "conservation" because it represents an attempt to conserve the resource by reducing grazing intensity. We use information from the sample on stocking rate to develop an index for conservation. To determine the index, we calculated the sample mean stocking rate (livestock units/ha). We, then, compared the stocking rate of the i th farmer to the sample mean and assigned a value of 1 if the individual stocking rate was below the sample mean and a value of zero otherwise.

Labor was measured as number of hours spent on farming activities. The cost of variable inputs was also recorded in the survey (i.e., veterinary and medicine costs, fertilizers, etc.). The size (in ha) of the commonage has been included in the analysis to control for physical characteristics.

Regulatory measures, supported by the Common Agricultural Policy (CAP) are known to play an important role in

supporting farm incomes and in influencing commonage management. Data were gathered on livestock premia as well as agri-environment measures such as REPS. These two instruments are very different. Premia are given on a headage basis. Thus, they can create an incentive to overgraze. REPS, instead, is a different scheme that aims to link financial support to environmental goals.

Finally all respondents were asked a series of questions on sources of household income and socioeconomic characteristics (i.e., age of the decisionmaker, availability of off-farm income), in order to determine which socioeconomic variables affect decisions to cooperate in the management of commonage.

IV. ECONOMETRIC ANALYSIS

In the model described below, we attempt to identify the main determinants of both conservation effort and cooperation within the commonage. Moreover, we argue that there is an obvious causal relationship between cooperation and conservation. The greater the probability that an individual farmer will cooperate in the management of commonage (i.e., gathering of stock, fencing, etc.), the higher the probability that an individual shareholder will take a step towards conservation. For instance, the active management of the commonage includes activities such as stock gathering. Thus, cooperation within the CPR can affect the number of livestock units per ha that are introduced on common land. The stock in turn dictates the grazing regime. Therefore, there is a need to adopt a model that can deal with such a situation. The essential feature of the model is that (1) it is recursive thus one of the important covariates, cooperation, is likely to be jointly determined with the conservation indicator that is also a binary variable; and (2) the response variable of interest, conservation is a binary variable.

A recursive bivariate probit method allows us to account for these two features.

TABLE 2
SUMMARY STATISTICS

Variable	Mean	Std. Dev.	Min.	Max.
Age	56.82	13.41	22	86
Size	512.92	745.07	0	7,916.67
Non farm	7,489.50	12,234.94	0	57,000
Shareholders	8.76	11.42	0	115
REPS	7,621.13	2,887.89	0	15,000
Premia	96.93	106.40	0	648
Labor	37.23	20.45	0	100
Cost	9,285.67	9,171.95	0	92,000
Cooperation	0.36	0.48	0	1
Conservation	0.7	0.45	0	1
Private land	22.68	37.42	0	416.67

Let us consider the following two equations:

Conservation = f_1 [labor, non-farm income, intensity of input use, private land, Agricultural policy₁(REPS), Agricultural policy₂(Premia), **Cooperation**]; [1]

Cooperation = f_2 [Age, size of the commonage share, non-farm income, number of active shareholders, Agricultural policy₁ (REPS), Agricultural policy₂(Premia)] [2]

A constant term is added in both equations. Table 2 reports the descriptive statistics. By construction, we have it that some of the variables that are predictors in the first equation are predictors for the second equation. Notably, the variable cooperation is endogenous but binary and it therefore appears on the right hand side of equation [1] only (Greene 1998). Thus the model is recursive, greatly simplifying the estimation. Given that both cooperation and conservation effort are binary variables we follow Greene (1998, 2000) and adopt a simultaneous recursive bivariate probit model.

Greene (1998) showed that this model provides an efficient and constituent way of handling recursiveness and simultaneity when the dependent variables are binary.

Thus, we just use the cooperation variable as a predictor in equation [1] and “proceed as if there were no simultaneity problem” (Greene 1998).

TABLE 3

BIVARIATE PROBIT MODEL—FULL INFORMATION LIKELIHOOD ESTIMATES

Variable	Coefficient	Std. Error
<i>Equation [1]—Dependent Variable: Conservation</i>		
Labor	0.009***	0.0011
Non-farm income	0.000025***	7.82 E-06
Private land	0.0047***	0.00074
Total cost	-0.000037***	0.0000115
REPS	0.0000574***	0.000018
Premia	-0.0065***	0.00069
Cooperation	1.4***	0.07
Constant	-0.2***	0.07
<i>Equation [2]—Dependent Variable: Cooperation</i>		
Age	-0.0091*	0.005
Size	0.0011***	0.0002
Non-farm income	-0.000011***	8.48 E-07
Shareholders	-0.0072	0.007
REPS	0.00006**	0.00003
Premia	0.0018	0.0022
Constant	-0.73	0.83
ρ	-0.91	0.03

Notes: $N = 282$; Wald Test: $\rho = 0$; $\text{Chi}^2 [1] = 56.63$; Log pseudo-likelihood = -100.388 . Robust standard errors have been used.

* Significant at the 10% level; ** significant at the 5% level; *** significant at the 1% level.

V. RESULTS

In what follows we report on the empirical relationship between cooperation and conservation. We also discuss the role of state intervention and shareholder dependence. The two variables of interest are cooperation and conservation and these are shown in Table 3. Recall that equation [1] above refers to the dependent variable, conservation, while equation [2] denotes the dependent variable cooperation. We first ran equations [1] and [2] separately. We found that the McKelvey and Zavoina’s R^2 was respectively 0.3 and 0.395. Table 3 reports the results of the estimation given by the recursive bivariate probit model. To this end, the correlation between the two structural disturbances ρ was estimated. The value is -0.91 . The Wald test identifies that we can reject the null hypothesis ($\rho = 0$) at the 1% significance level. This stresses that simultaneity is present and that there are unobserved characteristics that are positively correlated with y_1 and negatively correlated with y_2 . As mentioned earlier,

this model allows us to understand what makes cooperation more likely and to determine the role of cooperation on commonage conservation.

Table 3 shows that the estimated coefficients in equation [1] are all significant at the 1% level. Cooperation is positively and significantly correlated with the probability of conservation. Thus, cooperation is a significant determinant of conservation effort. Recall that conservation represents a conservation effort by individual shareholders. Cooperation therefore encourages shareholders to make a conservation effort toward provision. Cooperation is, therefore, a very important variable in determining the “success” of the rural institution in managing the common resource.

Labor, non-farm income, and the availability of private land are all positively correlated with conservation. These results are not surprising and stress the link between conservation and commonage dependence. Farmers that spend more time on farming activities are more likely to make a conservation effort. This is because they benefit from the ecological conditions of the land and are more aware of the implications of overgrazing. Farmers that have different sources of income or private land, tend to exploit common land less because they have alternative livelihoods which do not solely rely on commonage.

The estimated coefficient of the intensity of input use (captured by the total costs of inputs) is instead negatively correlated with conservation. This indicates that the intensification of activities negatively affect the probability of conservation.

Cooperation is also affected by a number of other variables. Table 3 indicates that the analysis of the estimated coefficients of equation [2] places emphasis on the role of age, size, and non-farm income on the probability to cooperate in the management of commonage. Both estimated coefficients of age and non-farm income are negative and statistically significant. This implies that younger farmers are more willing to cooperate than older farmers. It also suggests that the more farmers are involved

in other non-farm economic activities (such as part time employment, for example) the less they want to cooperate. Table 3 also shows that the size of the commonage share is, instead, positively correlated with cooperation suggesting that farmers with larger commonage shares are more likely to cooperate than those with smaller shares.

Cooperation, Conservation, and State Intervention

The impact of agricultural policy on conservation is quite different according to the two types of policy instrument. Indeed, Table 3 indicates that the REPS measure is positively and significantly correlated with conservation and does reduce the probability of overgrazing. Thus the REPS enhances the actions made by individual shareholders to make a conservation effort. On the other hand, livestock premia is negatively related to conservation and has the opposite effect. In other words livestock premia reduce the actions made by individual shareholders to make a conservation effort. In the case of livestock premia, this highlights a possible “perverse” effect of agricultural policy. It would appear to create an incentive to expand the number of animals that in turn will (over) graze commonage land.

The results are of considerable interest from an agricultural policy perspective. The REPS measure positively affects the probability of cooperation indicating that farmers who have signed up to this agri-environment scheme are more likely to cooperate than those who have not. As Table 3 shows, we tested for the effects of livestock headage premia on cooperation and results were not statistically significant.

The computation of the marginal effects, $y = \Pr(\text{conservation} = 1, \text{cooperation} = 1)$ highlights the importance of cooperation compared to the other explanatory variables. Indeed, the total marginal effect of cooperation is equal to 0.29, while the second most important impact refers to labor, age, and active. All these variables have a total marginal of 0.0022.

VI. CONCLUSIONS

The model presented above provides a framework for evaluating the effects of cooperation and agricultural policy on natural resource conservation of a CPR in Ireland. Our findings lead us to conclude that far from being redundant, commonage as a system of land tenure is significant because it embodies a number of rules developed over many centuries that encourage shareholders to cooperate. Commonage acts as a mechanism which facilitates cooperation between shareholders. Our empirical findings indicate that well-managed commonage institutions are capable of delivering a number of economic outcomes that would be difficult to achieve by private actors negotiating through market-based exchanges or state actors regulating through command-and-control policies.

First, our analysis indicates that farmers who cooperate with other shareholders are more likely to make a "conservation effort" that reduces overgrazing. This action produces both a private and public good at a farm and watershed scale. At a farm scale, the individual farmer benefits from improved forage quality and livestock offtake, and they also improve livestock yields for other shareholders in the same commonage. In this sense, cooperation moves production closer to a Pareto optimum than would the self-regarding decision by an individual farmer. These results support the findings of McCarthy, de Janvry, and Sadoulet (1998) who report that farmers who cooperate less also have higher stocking rates. Our findings also lend some support to Lopez (1998) and Ahuja (1998), who show that cooperation helps to conserve natural resources by restoring land fertility in Côte d' Ivoire.

Second, cooperative behavior by farmers can contribute toward a number of collective goods of conservation and recreation interest on a broader scale. These include the maintenance of peat bogs as well as heath and calcareous grasslands all of which provide important habitats for rare species (e.g., red grouse) and also reduce erosion, thus improving water quality.

Commonages cover extensive areas, occasionally over several thousand hectares, and cooperation may be the only means of managing a public good, such as a commonage watershed, at an ecologically appropriate scale (Lubell et al. 2002). The geographical nature and scale of many of the environmental concerns in the uplands (abatement of diffuse pollution, the enhancement of biodiversity, and landscape management) requires cooperation, or at the very least coordination, by multiple landowners. Agri-environment schemes such as REPS are frequently an ineffective way of delivering such benefits because the schemes are voluntary and focus on individual farms and not the watershed (Feehan, Gillmor, and Culleton 2005). While REPS may be effective in the delivery of certain landscape and amenity features (stone walls, hedgerows, woodlands) on individual farms, non-point pollution, broad scale habitat provision, and catchment erosion cause difficulties in monitoring, due to their geographically diffuse nature. The extensive movement of many wildlife types implies that they are ill-suited to local management, such as at the farm scale. For example it is recognized from island biogeography that larger areas are more effective habitats than smaller ones (MacArthur and Wilson 1967; van Dorp and Opdam 1987; Hodge and McNally 2000). Biodiversity often involves a range of environmental media such as land, air, and water calling for a degree of integrated management across large areas.

Third, cooperative behavior can also reduce the costs of state management because governments can decentralize environmental management by promoting farmer-based conservation initiatives. Decentralization serves to reduce state involvement and cuts the fiscal costs of management, monitoring, and inspections required under state-administered regimes. Instead, farmers take the initiative themselves to make a conservation effort and invest in provision (Li 1996; Heltberg 2001; Giertsen and Barrett 2004). This is based on the recognition that the fiscal capacity of the

state to undertake coercive conservation is limited and that communities can often manage their resources better than the state through its command and control policies.

Fourth, historically commonage was developed in order to provide an equitable system of landholding (Lafferty, Commins, and Walsh 1999). Our analysis indicates that the size of the commonage share is positively correlated with cooperation. Thus farmers who manage a large area of commonage are also more likely to cooperate with other shareholders in its management. This may suggest that farmers who are more dependent on commonage are also more likely to invest in its upkeep. This is a theme that has been well documented in the commons literature (see, e.g., Runge 1986; Ostrom 1990; Baland and Platteau 1997, 1998). Our experience of working with commonage farmers suggests that even today, commonage as a system of land tenure appears to be important in sustaining Irish farming families, particularly on marginal land along the western seaboard. Most commonage farmers continue to occupy small areas of private land, are on low incomes, and depend on extensive areas of commonage to supplement their incomes.

The model also considered the effects of agricultural policy on cooperative behavior and environmental management. The results are topical in the light of recent agricultural policy changes and trade negotiations since, somewhat uniquely, the study embraces two quite different types of policy on the cusp of substantial policy reform under the 2003 CAP Mid-Term Review (CEC 2002).

We show that CAP price incentives in the form of livestock premia do not affect cooperation by shareholders. However, we find that livestock premia have a negative impact on the conservation efforts of individual shareholders. This confirms concerns raised by a number of ecological studies that livestock headage allowances have encouraged excessive grazing (Bleasdale 1995; Bleasdale and Sheehy-Skeffington 1995; Emerson and Gillmor 1999; Hickie et al. 1999; Lafferty, Commins, and

Walsh 1999). Elsewhere, studies which use subsidies to promote livestock production and rural incomes have also led to uncontrolled overgrazing (McNeely 1993; Hess and Holechek 1995; Simpson et al. 1998; Caraveli 2000).

The impact of the agri-environment scheme, REPS, is quite different. The model reveals that farmers who have signed up to REPS are more likely to cooperate with other shareholders on a number of agronomic activities than those who have not. Thus, REPS may contribute towards improved forage quality, livestock productivity, and commonage conservation by supporting cooperation. By enhancing cooperation, REPS can also contribute toward public goods of conservation or recreation interest at the broader landscape scale. This is significant, since an aim of REPS is to contribute towards the maintenance of environmental public goods that benefit the wider community (Lowe and Brouwer 2000; CEC 2002; Matthews 2002). Our findings indicate REPS has a positive impact on the management of commonage and some of the broader environmental goals which the scheme was designed to achieve. There is no direct reason why REPS should encourage cooperation, since collective action is not an explicit objective of REPS. However, REPS does implicitly aim to improve farmers' awareness, behavior and attitudes to environmental public goods through education and training (which is a requirement of REPS).

Given the substantial level of farm support and the reluctance of the agricultural sector to reduce farming intensity without some form of compensation, it is difficult to envisage a situation in which commonage is managed in the absence of state intervention. Indeed we do not advocate such an approach. Research which involves CPRs and agri-environment schemes recommends that state intervention is necessary to support collective action (Wilson and Wilson 1997; Grafton 2000; Hodge and McNally 2000; Short 2000; Giertsen and Barrett 2004; Fujiie, Hayami, and Kikuchi 2005). Although we are in

broad agreement with this perspective, we suggest a number of steps be taken to make agricultural policy more effective in supporting cooperation and local institutions for commonage management.

First, the state and the EU should continue the process to fully decouple income support to farmers from price support (Brouwer and Lowe 2000; Buller 2000; Buller, Wilson, and Holl 2000; Lowe and Baldock 2000; CEC 2002).

Second, agricultural agencies involved with REPS should promote its dissemination in commonage areas. Since we note that REPS farmers are more predisposed than non-REPS farmers in the management of an environmental public good such as commonage, the establishment of local forums could provide a means of galvanizing farmer support for REPS (Afcon 2003).

Third, there are currently limited incentives specifically designed to encourage farmers to undertake collective planning or implementation of environmental or productive activities. Agri-environment schemes like REPS are, instead, targeted at individual farmers and not groups. Incentives should be made available to offer choices to land managers to operate either as individuals or part of a group. Policy could also avoid focusing on individual farm management plans and use forums to extend the range of participants involved in agri-environment scheme design and control (Short 2000).

Fifth, the remit of advisory services could be broadened to involve group-oriented extension activities in order to stimulate and build on the historic tradition of existing cooperative activities that has developed through commonage management. This could promote farmer involvement in agri-environment schemes and make use of local knowledge in the management of commonage as suggested by Feehan, Gillmor, and Culleton (2005) and Short (2000).

In conclusion, our empirical results serve as a reminder that CPRs which occur in developed countries can play an important role in resource conservation and in sus-

taining rural livelihoods. We also suggest that a tradition of local cooperative behavior that has developed through managing commonage land can play a significant role in supporting regulation as a means of managing environmental public goods that benefit the wider community. Through cooperative approaches, problems which are difficult to solve by command-and-control institutions, such as non-point source pollution and enhancement of biodiversity, can be tackled (Lubell et al. 2002). This approach can also foster solutions that are more durable over the longer term and which promote self-monitored norms of cooperation and avoid costly legal and administrative compliance mechanisms (Ostrom 2000a).

References

- Afcon. 2003. "Mid-Term Evaluation of the CAP Rural Development Plan (CAP RDP) (2000–2006)." Report by Afcon Management Consultants and University College Cork.
- Ahuja, V. 1998. "Land Degradation, Agricultural Productivity and Common Property: Evidence from Côte d'Ivoire." *Environment and Development Economics* 3 (1): 7–34.
- Almquist, E. 1977. "Mayo and Beyond: Land, Domestic Industry, and Rural Transformation in the Irish West." PhD diss., Department of Anthropology, Boston University.
- Andrews, J. H. 1987. "The Struggle for Ireland's Public Commons." In *Rural Ireland 1600–1900*, ed. P. O'Flanagan, P. Ferguson, and K. Whelan. Cork, Ireland: Cork University Press.
- Baland, J. M., and J. P. Platteau. 1996. "Halting Degradation of Natural Resources. Is There a Role for Rural Communities?" Oxford, U.K.: Clarendon Press.
- Baland, J. M. 1997. "Coordination Problems in Local-level Resource Management." *Journal of Development Economics* 53 (1): 197–210.
- . 1998. "Division of the Commons: A Partial Assessment of the New Institutional Economics of Land Rights." *American Journal of Agricultural Economics* 80 (3): 644–50.
- Bleasdale, A. 1995. "The Vegetation and Ecology of the Connemara Uplands, with Particular Reference to Sheep Grazing." PhD diss., National University Ireland, Galway.
- Bleasdale, A., and M. Sheehy-Skeffington. 1995. "The Upland Vegetation of North-East Con-

- nemara in Relation to Sheep Grazing." In *Irish Grasslands, Their Biology and Management*, ed. D. W. Jefferey, M. B. Jones and J. H. McAdam. Dublin, Ireland: Royal Irish Academy.
- Bromley, D. W. 1991. *Environment and Economy: Property Rights and Public Policy*. Oxford, U.K.: Blackwell.
- . 1998. "Determinants of Cooperation and Management of Local Common Property Resources." *Discussion* 80 (3): 665–68.
- Bromley, D. W., ed. 1992. *Making the Commons Work: Theory, Practice, and Policy*. San Francisco: Institute of Contemporary Studies Press.
- Bromley, D. W., and I. Hodge. 1990. "Private Property Rights and Presumptive Policy Entitlements: Reconsidering the Premises of Rural Policy." *European Review of Agricultural Economics* 17 (2): 197–214.
- Brouwer, F., and P. Lowe. 2000. "CAP and the Environment: Policy Development and the State of Research." In *CAP Regimes and the European Countryside*, ed. F. Brouwer and P. Lowe. U.K.: CABI Publishing.
- Buller, H. 2000. "Regulation 2078/92: Patterns of Implementation." In *Agri-environmental Policy in the European Union*, ed. H. Buller, G. A. Wilson, and A. Holl. U.K.: Ashgate Publishing Ltd.
- Buller, H., G. A. Wilson, and A. Holl. 2000. "Introduction: the Emergence of Regulation 2078/92" In *Agri-environmental Policy in the European Union*, ed. H. Buller, G. A. Wilson, and A. Holl. U.K.: Ashgate Publishing.
- Caraveli, H. 2000. "A Comparative Analysis on Intensification and Extensification in Mediterranean Agriculture: Dilemmas for LFAs policy." *Journal of Rural Studies* 16 (2): 231–42.
- Central Statistics Office (CSO). 2002. "Census of Agriculture, Main Results, June 2000." Cork, Ireland: CSO.
- Commission of the European Communities (CEC). 1993. "Community Policy for Aid to Farms in Hill, Mountain and Less-Favoured Areas." Green Europe series. Luxembourg: Office for Official Publications of the European Communities.
- . 1998. "Agenda 2000: The Future of European Agriculture." Directorate-General of Agriculture (DG VI), Brussels. Web address: <http://europa.eu.int/en/comm/dg06/> (accessed July 15, 2006).
- . 2002. "Communication from the Commission to the Council and the European Parliament: Mid-Term Review of the Common Agricultural Policy." COM(2002), July 20, 2002. Brussels: European Commission.
- . 2006. "Census of Population 2006. Main Results, June 2006." Cork, Ireland: CSO.
- Department of Agriculture, Food and Forestry (DAFF). 1996. "Rural Environment Protection Scheme, Report on Agri-Environmental Specifications." Dublin, Ireland: Department of Agriculture, Food and Forestry.
- . 2004. "Terms and Conditions of the Rural Environment Protection Scheme (REPS)." Dublin, Ireland: Department of Agriculture, Food and Forestry.
- de Janvry, A., N. McCarthy, and E. Sadoulet. 1998. "Endogenous Provision and Appropriation in the Commons." *American Journal of Agricultural Economics* 80 (3): 658–64.
- Douglas, C. 1995. "Overgrazing in Ireland: Some Impacts." National Parks and Wildlife Service Staff Report: Dublin, Ireland.
- Emerson, H. J., and D. Gillmor. 1999. "The Rural Environment Protection Scheme of the Republic of Ireland" *Land Use Policy* 16 (4): 235–45.
- Feehan, J., D. A. Gillmor, and N. Culleton. 2005. "Effects of an Agri-Environment Scheme on Farmland Biodiversity in Ireland." *Agriculture Ecosystems and Environment* 107 (2/3): 275–86.
- Feeny, D., S. Hanna, and A. F. McEnvoy. 1996. "Questioning the Assumptions of the 'Tragedy of the Commons' Model of Fisheries." *Land Economics* 72 (May): 187–205.
- Fujiie, M., Y. Hayami, and M. Kikuchi. 2005. "The Conditions of Collective Action for Local Commons Management: The Case of Irrigation in the Philippines." *Agricultural Economics* 33 (2): 179–89.
- Gebremedhin, B., J. Pender, and G. Tesfay. 2004. "Collective Action for Grazing Land Management in Crop-Livestock Mixed Systems in the Highlands of Northern Ethiopia." *Agricultural Systems* 82 (3): 273–90.
- Giertsen, H., and C. B. Barrett. 2004. "Context-Dependent Biodiversity Conservation Management Regimes: Theory and Simulation." *Land Economics* 80 (Aug.): 321–39.
- Grafton, R. Q. 2000. "Governance of the Commons: A Role for the State?" *Land Economics* 76 (Nov.): 504–17.
- Greene, W. 1998. "Gender Economics Courses in Liberal Arts Colleges: Further Results." *Journal of Economic Education* 29 (4): 291–300.
- . 2000. *Econometric Analysis*. 4th ed. Boston, Mass.: Prentice Hall.
- Hanley, N., H. Kirkpatrick, I. Simpson, and D. Oglethorpe. 1998. "Principles for the Provision of Public Goods from Agriculture: Modeling Moorland Conservation in Scotland." *Land Economics* 74 (Feb.): 102–13.

- Hegan, R. L., G. Hauer, and M. K. Luckert. 2003. "Is the Tragedy of the Commons Likely? Factors Preventing the Dissipation of Fuelwood Rents in Zimbabwe." *Land Economics* 79 (May): 181–97.
- Heltberg, R. 2001. "Determinants and Impact of Local Institutions for Common Resource Management." *Environment and Development Economics* 6 (2): 183–208.
- Hess, K., and J. L. Holechek. 1995. "Policy Roots of Land Degradation in the Arid Region of the United States: An Overview." *Environmental Monitoring and Assessment* 37 (1–3): 123–41.
- Hickie, D., E. Smyth, U. Bohnsack, S. Scott, and D. Baldock. 1999. "A Report on the Impact of Agricultural Schemes and Payments on Aspects of Ireland's Heritage." Kilkenny, Ireland: The Heritage Council.
- Hodge, I., and S. McNally. 2000. "Wetland Restoration, Collective Action and the Role of Water Management Institutions." *Ecological Economics* 35 (1): 107–18.
- Hynes, S., C. Buckley, and T. van Rensburg. 2007. "Recreational Pursuits on Marginal Farm Land: a Discrete-Choice Model of Irish Farm Commonage Recreation." *Economic and Social Review* 38 (1): 63–84.
- Kelly, F. 1997. *Early Irish Farming: A Study Based on the Law-Texts of the 7th and 8th Centuries*. A.D. Dundalk, Co. Louth: Dundagan Press.
- Lafferty, S., P. Commins, and J. A. Walsh. 1999. *Irish Agriculture in Transition: a Census Atlas of Agriculture in the Republic of Ireland*. Dublin, Ireland: Teagasc.
- Li, T. M. 1996. "Images of Community: Discourse and Strategy in Property Relations." *Development and Change* 27 (3): 501–27.
- Lopez, R. 1993. "Resource Degradation, Community Controls and Agricultural Production in Tropical Areas." Working Paper 93-08, Department of Agriculture and Resource Economics, University of Maryland: College Park, Maryland.
- . 1997. "Environmental Externalities in Traditional Agriculture and the Impact of Trade Liberalization: the Case of Ghana." *Journal of Development Economics* 53 (1): 17–39.
- . 1998. "The Tragedy of the Commons in Côte d'Ivoire Agriculture: Empirical Evidence and Implications for Evaluating Trade Policies." *World Bank Economic Review* 12 (1): 105–31.
- Lowe, P., and D. Baldock. 2000. "Integration of Environmental Objectives into Agricultural Policy Making." In *CAP Regimes and the European Countryside*, ed. F. Brouwer and P. Lowe. U.K.: CABI Publishing.
- Lowe, P., and F. Brouwer. 2000. "Agenda 2000: A Wasted Opportunity?" In *CAP Regimes and the European Countryside*, ed. F. Brouwer and P. Lowe. U.K.: CABI Publishing.
- Lubell, M., M. Schneider, T. J. Scholz, and M. Mete. 2002. "Watershed Partnerships and the Emergence of Collective Action Institutions." *American Journal of Political Science* 46 (1): 148–63.
- Lyall, A. 2000. *Land Law in Ireland*. 2nd. ed. Dublin, Ireland: Oak Tree Press.
- MacArthur, R. H., and E. O. Wilson. 1967. *The Theory of Island Biogeography*. Princeton, N.J.: Princeton University Press.
- McCarthy, N., A. de Janvry, and E. Sadoulet. 1998. "Land Allocation Under Dual Individual-Collective Use in Mexico." *Journal of Development Economics* 56 (2): 239–64.
- McCarthy, N., E. Sadoulet, and A. de Janvry. 2001. "Common Pool Resource Appropriation Under Costly Cooperation." *Journal of Environmental Economics and Management* 42 (3): 297–309.
- McNeeley, J. A. 1993. "Economic Incentives for Conserving Biodiversity: Lessons for Africa." *Ambio* 22 (2/3): 144–50.
- Matthews, A. 2002. "Future Role of REPS under a Changing CAP." Paper presented at the National REPS Conference, Delivering for Farming and the Environment. Teagasc, Carlow.
- Nugent, F. 1995. "Managing the Upland Regions of Ireland." In *Seeking a Partnership Towards Managing Ireland's Uplands*, ed. D. Hogan and A. Phillips, Proceedings of a conference held in University College Galway, 13–15 October, 1995.
- O'Keefe, C. 2005. "The National Parks and Wildlife Service Farm Plan Scheme for Designated Areas and Commonage." Proceedings from 2005 Teagasc National REPS Conference 'REPS 3—Assisting Change in Farming, November 4, 2005, Teagasc, Carlow.
- Ostrom, E. 1990. *Governing the Commons*. Cambridge, U.K.: Cambridge University Press.
- . 1992. *Governing the Commons. The Evolution of Institutions for Collective Action*. Cambridge, U.K.: Cambridge University Press.
- . 2000a. "Collective Action and the Evolution of Social Norms." *Journal of Economic Perspectives* 14 (3): 137–58.
- . 2000b. "Private and Common Property." In *Encyclopedia of Law and Economics*, Vol. 1, ed. B. Bouckaert and G. De Geest. Cheltenham, U.K.: Edward Elgar.

- Phillips, W. E., and M. Tubridy. 1994. "New Supports for Heritage Tourism in Rural Ireland." *Journal of Sustainable Tourism* 2 (1/2): 112–29.
- Runge, C. F. 1986. "Common Property and Collective Action in Economic Development." *World Development* 14 (5): 623–35.
- Short, C. 2000. "Common Land and ELMS: a Need for Policy Innovation in England and Wales." *Land Use Policy* 17 (2): 121–33.
- Simpson, I. A., A. H. Kirkpatrick, L. Scott, J. P. Gill, N. Hanley, and A. J. MacDonald. 1998. "Application of a Grazing Model to Predict Heather Moorland Utilization and Implications for Nature Conservation." *Journal of Environmental Management* 54 (3): 215–31.
- Stevenson, G. G. 1991. *Common Property Economics: A General Theory and Land Use Applications*. Cambridge, U.K.: Cambridge University Press.
- van Dorp, D., and P. F. M. Opdam. 1987. "Effects of Patch Size, Isolation and Regional Abundance on Forest Bird Communities." *Landscape Ecology* 1 (1): 59–73.
- Wade, R. 1987. *Village Republics: Economic Conditions for Collective Action in South India*. Cambridge, U.K.: Cambridge University Press.
- Webb, D. A., and M. J. P. Scannell. 1983. *Flora of Connemara and the Burren*. Cambridge, U.K.: Royal Dublin Society and Cambridge University Press.
- Whelan, K. 1999. "Landscape and Society on Clare Island 1700–1900." In *New Survey of Clare Island. Volume I: History and Cultural Landscape*, ed. C. Mac Cárthaigh and K. Whelan. Dublin, Ireland: Royal Irish Academy.
- Wilson, O. J., and G. A. Wilson. 1997. "Common Cause or Common Concern? The Role of Common Lands in the Post-Productivist Countryside." *Area* 29 (1): 45–58.