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A project of economic-ecological analysis of wolf-livestock interactions in Spain

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SUMMARY – Extensive livestock systems are with increasing frequency facing complex issues balancing the social and economic needs of the farmers and the maintenance of traditional farming systems, with environmental and wildlife conservation considerations. This type of human-wildlife conflict is illustrated by the introduction of wolf conservation measures in Europe in areas where sheep are extensively managed. This has occurred in the Basque region of Spain, where sheep farmers are being severely affected by wolf predation. Although compensation payments are available to farmers, their real impact in reducing the social and economic costs of wolf presence have yet to be analysed, and it may be that the continuation of extensive sheep farming and improvement of livestock quality are being compromised at the current level of financial schemes. It is therefore desirable that the actual level of economic damage to extensive sheep farmers is assessed and quantified so that the trade-offs between wolf conservation and the preservation of the extensive livestock systems can be objectively accomplished. This project aims to provide policy guidelines for the management of livestock and wolf populations in the Basque country at both farm and landscape levels. The proposed methodology will take an interdisciplinary approach, including farmer-participatory techniques and economic-ecological analysis and modelling. The project will integrate economic optimisation of livestock production with GIS-based predictive modelling of wolf movements and of wolf-livestock interactions. Integrating ecological and economic modelling within a GIS framework will allow area-specific predictions to be made of changes in wolf populations and/or sheep management practices on the economic impact of wolf predation on sheep farming. The output from this work will be used to make policy recommendations for the future management of the wolf-livestock interactions.

Key words: Wolves, ecological-economic modelling, rural sustainability, Basque Country.

RESUME – *"Un projet d'approche écologico-économique de l'étude des interactions loups-cheptel en Espagne". De plus en plus souvent, les systèmes d'élevage extensif se trouvent confrontés à des problèmes complexes ; il s'agit de trouver un juste équilibre entre les besoins socio-économiques des agriculteurs et le maintien de systèmes agricoles traditionnels, en tenant compte des considérations liées à la conservation de l'environnement, de la faune et de la flore. Ce type de conflit entre l'être humain et la faune est illustré par l'introduction de mesures de conservation du loup en Europe dans des zones d'élevage ovin extensif. Cela s'est produit dans la région basque de l'Espagne, où les éleveurs de moutons sont fortement touchés par la prédation des loups. Bien que des dédommagements soient offerts aux agriculteurs, on n'a pas encore analysé dans quelle mesure ils réussissent véritablement à réduire les coûts socio-économiques de la présence des loups ; il se peut que le niveau actuel des programmes financiers soit en train d'ébranler la continuation de l'élevage ovin extensif et l'amélioration de la qualité du cheptel. Il est donc souhaitable d'évaluer et de quantifier le niveau actuel du préjudice économique subi par ceux qui pratiquent l'élevage ovin extensif, pour trouver des compromis objectifs entre la conservation du loup et la préservation des systèmes d'élevage extensif. Ce projet vise à fournir des lignes directrices pour les politiques de gestion du cheptel et des populations de loups au Pays basque, aussi bien au niveau des exploitations agricoles qu'au niveau du paysage. La méthodologie proposée adoptera une approche pluridisciplinaire, en faisant appel à des techniques impliquant la participation des agriculteurs ainsi qu'à une analyse et à une modélisation économiques-écologiques. Le projet intégrera une optimisation économique de la production du bétail avec une modélisation prédictive, basée sur un SIG, des mouvements des loups et des interactions loups-bétail. Les résultats de ces travaux serviront à recommander des politiques pour la gestion future des interactions loups/bétail.*

Mots-clés : *Loups, modélisation écologico-économique, durabilité rurale, Pays basque.*

Introduction

One of the most critical areas of natural resource management to have arisen in recent years is that of conflict between wildlife and human interests. Increasing expansion of human populations, coupled with greater environmental demands, has resulted in competition with wildlife for space and resources. This is most clearly illustrated in the case of space/resource demands between livestock and large carnivores within extensive livestock systems. The resolution of these conflicts requires strong partnerships and shared goals for both wildlife and human communities.

Conflicts between wolves (*Canis lupus*) and farmers are common throughout most of the current European wolf range and represent one of the most pertinent problems in wolf conservation programs (Telleria and Saez-Royuela, 1989; Mech, 1995; Bangs *et al.*, 1996; Cozza *et al.*, 1996; Breitenmoser, 1998; Ciucci and Boitani, 1998a,b). Wolf populations in northern and Mediterranean Europe have been shown to take considerable numbers of livestock (Meriggi *et al.*, 1991, 1996; Blanco *et al.*, 1992; Ciucci and Boitani, 1998a,b) and this has commonly been responded to by eradication efforts against wolf populations by pastoralist communities (Kaczensky, 1996), leading to extensive decreases in wolf populations' distribution and size (Meriggi and Lovari, 1996). Society's interest in wildlife conservation has led to the introduction of legal protection of wolves in many European countries, and a concomitant introduction of compensation programmes by governments to assuage the losses incurred by livestock farmers (Fourli, 1999), e.g. in Italy, France, Greece, Norway and Croatia (Boitani, 2000) and in parts of Spain (Blanco *et al.*, 1992).

Compensation payments respond to the need to distribute equitably the costs of conservation of large predators in agricultural areas. However, the role of compensation payments in wolf conservation strategies, and in reducing social and economic costs of wolf presence, has yet to be analysed. In some areas of lowland Italy, high levels of compensation payments to farmers have been politically unpopular (Ciucci and Boitani, 1998a,b), but in Spain, compensation to farmers for loss of livestock through wolf predation comprises only 25% of the estimated damage (Blanco *et al.*, 1992). In central Italy, eight years of study showed that compensation programmes alone were not effective in reducing wolf-livestock farmer conflicts or in preventing illegal efforts to control wolf numbers (Ciucci and Boitani, 1998a,b). Thus the role of compensation payments in maintaining farm incomes and wolf conservation programmes is still unclear.

The intensity of wolf-livestock conflicts is affected not only by compensation practices but also by the level of livestock predation occurring. The abundance of a number of wild ungulates species has been identified as important in diverting predator pressure from domestic livestock (Cozza *et al.*, 1996; Vos, 2000). A number of other resources, such as forest cover and human population pressure, have also been shown to be related to wolf presence, which have provided predictive models of wolf movements in northern Italy (Massolo and Meriggi, 1998) and the USA (Treves *et al.*, 2001).

Research has very recently been initiated in Italy to consider the effectiveness of compensation payments in wolf conservation (Boitani *et al.*, 2002). However, further work is required to consider the relationship between resource availability, compensation payments and levels of wolf-livestock conflict. Knowledge about livestock losses (Fico *et al.*, 1993; Boitani and Ciucci, 1996) as well as costs, trends and effectiveness of compensation programmes is still limited (Ciucci *et al.*, 1997; Ciucci and Boitani, 1998, 1998a,b), and other factors in this relationship have never been quantified.

Research project aims and relevance

The proposed research will take place in the westerly region of the Basque Country, Spain. The Spanish wolf population is currently expanding into this region, which supports extensive livestock farming and has been classed as an EC Objective 5b area.

The project aims to develop predictive models to relate patterns of wolf abundance, movement and livestock predation to factors including prey abundance, habitat suitability and livestock management. The economic impact of wolf predation on livestock production in the study area will then be quantified. The results from these analyses will be combined into a Geographic Information System (GIS) based ecological-economic model of wolf-livestock interactions. The output from this geo-referenced ecological-economic model will be used to make policy recommendations for the future management of the wolf-livestock interactions in the region and elsewhere.

Beyond its inherent importance in increasing the knowledge of wolf-livestock interactions, the choice of this study area is important as it is reported (R. Ruiz, pers. comm.) that a number of farmers in the region have been severely affected by wolf depredation on livestock. Compensation payments are available for livestock damage but are perceived as being insufficient to cover financial losses. In addition, efforts to improve stock quality and production are perceived as meaningless if livestock is constantly under threat. There are two significant consequences of this: (i) farmers are leaving the occupation; and (ii) wolf persecution is increasing, with up to one day per week being spent in wolf hunting activities by members of the farming community (R. Ruiz, pers. comm.). The combination of these factors highlights the need for an adequate management plan from the Basque authorities in terms of wolf-livestock management. There is therefore a clear need to obtain precise knowledge and understanding of the economic effects on livestock farmers of wolf populations. In particular, there is a necessity to determine how current levels of compensation payments relate to actual livestock damage and how these payments are affecting the long-term viability of livestock farming. Assessment of the movements of the wolf population in relation to resource availability, e.g. livestock and prey abundance, is also required to enable predictive models of wolf movements to be developed.

Although compensation payments for livestock damage have been provided within Europe for over two decades, assessment of the effectiveness of these programmes in terms of farm livelihoods and wolf conservation has never been made. This research will therefore provide the first opportunity to develop and disseminate methodologies for assessing the efficacy of compensation payments in the dual context of wolf conservation and farming sustainability. In addition, the results produced will give rise to the development of appropriate policy guidelines in this field.

The methodology of this research not only combines ecological and economic analysis to produce an entirely integrated modelled output, but does so within a spatial framework. The integration of the disciplines of ecology and economics is comparatively new, but its value as an innovative and essential approach to managing natural resources is becoming increasingly well-recognised within the scientific community (Perrings *et al.*, 1992; Perrings, 1995). The use of GIS for spatial economic analysis is also relatively novel, and has previously been demonstrated to be effective for travel cost analysis and benefit transfer (Barbier *et al.*, 1994). GIS will be used in the proposed work to model farmer behaviour geographically with wolf population density. This will allow an economic assessment of the impact of wolves and compensation schemes that is area-specific.

Materials and methods

The methodology will follow four principal stages:

(i) Developing predictive models of wolf predation in relation to livestock management. Field measurements will be made of wild prey density and presence. Estimates will be made using indirect assessment methods of track and dung counts. These counts will be made in a set of randomly stratified quadrats throughout the study area using faecal clearance and recount methodologies. The field sites areas and patterns of prey distribution will then be digitally mapped using a GPS system. Data will also be collected on wolf abundance and density, using both indirect tracking methods and questionnaire assessment of the local community. Data on ecological, physical and geographical attributes of the study area will also be digitised.

(ii) Assessing the economic impact of wolf predation on extensive farming systems. Socio-economic data will be collected to use in model parameters. The data collection will be carried out in a questionnaire survey of extensive livestock farmers in the study area. Questionnaire details will cover: farm expenditures and incomes, livestock production data, socio-economic data relating to wolf attacks, and biological data relating to wolf attacks.

(iii) Development of a GIS-based ecological-economic model. The livestock and ecological previously collected in part (i) will be assimilation to give a digital coverage across the study area. This geo-referenced database will be used to build a spatially-based ecological-economic model.

(iv) Development of guidelines to give policy support for the management of wolf populations and livestock systems.

The model output will provide geo-referenced policy recommendations facilitating decisions over the optimal management of wolf and livestock in both economic and ecological terms.

Conclusions

The research not only combines ecological and economic analysis to produce an entirely integrated modelled output, but does so within a spatial framework. The integration of the disciplines of ecology and economics is comparatively new, but its value as an innovative and essential approach to managing natural resources is becoming increasingly well-recognised within the scientific community (Perrings *et al.*, 1992; Barbier *et al.*, 1994; Perrings, 1995). The use of GIS for spatial economic analysis is also relatively novel, and has previously been demonstrated to be effective for travel cost analysis and benefit transfer (Brainard *et al.*, 1999). GIS will be used in the proposed work to model farmer behaviour geographically with wolf population density. This will allow an economic assessment of the impact of wolves and compensation schemes that is area-specific.

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The project's ultimate objective is to produce policy guidelines for reducing conflicts arising between wildlife and human interests in Spain. It is anticipated that this methodology could be applied to other wildlife-human interactions, both within and outwith Europe. Although set within a unique set of ecological, cultural and economic circumstances, these issues will have similar underlying principles to which the same approach may be taken.

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