

Chapter 5

Change in Natural Resource Management: An Experiment with “Participatory GIS”

Stefano Fiorini

Abstract Natural resource management is a dynamic and adaptive science that responds to changes in the social, economic, and ecological factors pertaining to the managed resource(s). It requires and involves interactions and mediations at different spatial scales and of different knowledge pools and stakes. Participatory approaches can facilitate these interactions and mediations if structured so that collaboration can exist, conflicts are resolved, and knowledge exchange is enhanced. In this chapter, I discuss the application of a spatially explicit participatory GIS (PGIS) to bring together communities of managers, ecologists, and government and NGO representatives in two high-conflict areas of Scotland to discuss conflicts and develop a common knowledge and understanding of red deer and their management. I will first discuss the approach taken during a project that consisted of map-based interviews, secondary data collection, analysis, modeling, and two workshops that engaged stakeholders. Next I will discuss the results of the analysis and illustrate how comanagement and adaptation are currently taking place in deer management in

This research is part of the United Kingdom Research Councils’ Rural Economy and Land Use (RELU) program’s project “Collaborative Frameworks in Land Management” (Project: RES 227-025-0014). RELU is funded jointly by the Economic and Social Research Council, the Biotechnology and Biological Sciences Research Council, and the Natural Environment Research Council, with additional funding from the Scottish Government’s Department for Environment, Food, and Rural Affairs. Funding for this project was also provided by the Forestry Commission, United Kingdom. I would like to thank the above for their financial support for this research and other team members who worked with me in this project: Justin Irvine, Steve Yearley, Helen Armstrong, Jim McLeod, and Amy Turner. I also extend my sincere gratitude to the members of the Deer Management Groups and other stakeholders involved with the project who made our work possible.

S. Fiorini (✉)

Department of Anthropology, Indiana University, 701 E. Kirkwood Avenue,
Bloomington, IN 47405-7100, USA
e-mail: sfiorini@indiana.edu

Scotland. This discussion will contain an overview of the reaction of the participants to the PGIS approach. In the end, I will outline some critical consideration for discussion of the role participation can and should have in informing and addressing natural resource management.

5.1 Introduction

Natural resource management is a dynamic and adaptive science that responds to changes in the social, economic, and ecological factors pertaining to the managed resource(s). Among the driving forces behind changes in management objectives in recent decades, one can cite the need to preserve biodiversity and ecosystem functionalities in the effort of preserving the ecological foundations of human livelihoods (MA 2005a, b).

Until recently, management of natural resources with the objective of preserving both biodiversity and the functioning of ecosystems has been concentrated in bounded, designated areas such as national parks and national nature reserves. It is evident now that bounding resources is not enough to guarantee their long-term functionality (e.g., Brondizio et al. 2009; Ostrom and Nagendra 2006), and that there is a need to optimize management to respond to social, economic, and environmental needs over an unbounded landscape. Unbounding the managed landscape breaks those boundaries that separated different practices and objectives for land and resource management, requiring, more often than not, the mediation of conflicting cultural-economic understandings of the managed space and transforming management into a social process.

In various European countries, ecosystem-scale management has jumped to the forefront of the agenda of statutory bodies due to the need of meeting international obligations incorporated into European and national legislations. This has been the case in recent years in Scotland, the site of the case studies discussed in this chapter. Here, governmental organizations have recognized the importance of developing partnerships with private landowners, NGOs, communities, and research providers, building on preexisting forms of comanagement arrangements, like the Deer Management Groups, or building new ones, for example, management groups tasked to address the requirements of the Water Framework Directive. These partnerships would ideally work as “bridging organizations,” arenas for developing the needed elements of adaptive governance and comanagement, that is, “knowledge production, trust building, sense making, learning, vertical and horizontal collaboration, and conflict resolution” (Berkes 2009: 1695; see also Folke et al. 2005; Hahn et al. 2006; Olsson et al. 2007, 2008). Participatory approaches, by being processes inclusive of those who hold a stake in the managed resource(s), have the potential for meeting the needs of comanagement partnerships and bridging organizations if structured in a way that conflicts are addressed, collaboration and knowledge exchange is enhanced, and power and resources are shared.

The Scottish case studies this chapter is based on are ideal for investigating the elements affecting contemporary management of natural resources for several reasons. Changes in landownership and increased land fragmentation, combined with the vagility of wild deer in Scotland that knows no boundary (unless, of course a fence, often very costly, obstructs its passage), is increasingly requiring wild deer to be managed over an unbounded landscape. Increasing deer populations are affecting the capacity of ecosystems in various areas to meet the standards set by the legislation. This forces government intervention through the establishment of a variety of partnerships or enforcing changes in deer management. In Scotland, a form of comanagement/a network of bridging organizations, called Deer Management Groups (DMGs), has been in place for nearly three decades.

Various forms of managers’ participation in comanagement arrangements and in the working of deer management organizations will provide examples of their diversity. Next to these examples I will illustrate the application of a participatory geographic information system (PGIS) as a platform for knowledge sharing and production, sense making, learning, and conflict resolution. This will highlight the advantages and shortcomings of the application of PGIS as a tool in natural resources management. Among the elements that made the choice of a PGIS relevant is the fact that we are discussing a case of a resource that is mobile and that conflicts over the management of deer derive from the diversity of management objectives existing over the landscape. Various case studies have discussed the value that GIS-supported participatory approaches have for collecting information, supporting analysis, and integrating knowledge (Bacic et al. 2006; Irvine et al. 2009; Ramsey 2009). It has also been shown that PGIS has the potential for enhancing participation, mediation, and planning (Fedra 1995; Janssen et al. 2006; Sandström et al. 2003; Smith 2002; Wang et al. 2008). PGIS was originally chosen as a method in this project as a tool for integrating scientists and practitioners’ knowledge (see Irvine et al. 2009). During the project design, this original objective was expanded to include analysis of conflicts and participants’ evaluation of PGIS effectiveness for landscape-level deer management, incorporating emergent discussions on the importance and opportunity that PGIS offers in bringing together different forms of knowledge and enhancing power sharing (e.g., Ramsey 2009; Wright et al. 2009).

5.2 Data and Methods

The case studies discussed here were selected based on the advice of a panel of representatives of deer management NGOs, environmental NGOs, and governmental institutions. The selection aimed at maximizing the diversity of settings in which deer management occurs in Scotland, in terms of properties’ sizes, characteristics of the landscape, and vicinity to urban centers, as well as investigating areas in which changes in management objectives, due to shifts in public policies or changes in landownership, increased the intra-DMGs conflicts. The work was conducted between 2006 and 2009.

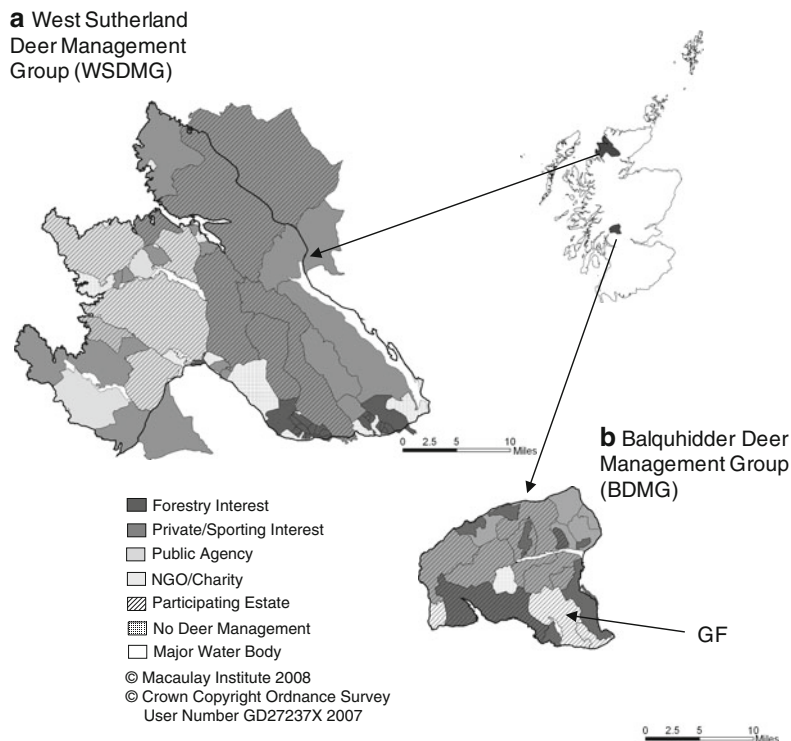


Fig. 5.1 Case study areas and distribution of main land-use objectives (from Irvine et al. 2009)

Figure 5.1 shows the location of the two case studies and maps the diversity of land-use objectives/ownerships. The selected areas coincide with the boundaries of two DMGs. DMGs are networks of voluntary organizations with the objective of bringing together interested parties to facilitate discussion of and coordinate deer management in units of a landscape that are thought to contain a limited number of deer populations. Even if examples of DMGs existed from the late 1960s (Finnie 2004), it is with the support of a statutory body, the Red Deer Commission, the precursor of the Deer Commission for Scotland (DCS), which was merged in August of 2010 with the Scottish National Heritage (SNH), that the number of DMGs grew from a total of 10 in 1979 to about 45 in 2001 (Nolan et al. 2001). Today there are more than 70 DMGs in Scotland, including groups and subgroups (ADMG 2008). Two groups—Balquidder and West Sutherland—are discussed in this chapter.

Balquidder DMG (BDMG) is located in central Scotland and covers an area of about 44,000 ha. At the time of the survey, the average size of the subgroups for which the research team had data was about 1,700 ha, with a maximum of about 7,000 ha and a minimum of about 200 ha. West Sutherland DMG (WSDMG) is located in northwest Scotland and has an approximate total area of 149,900 ha.

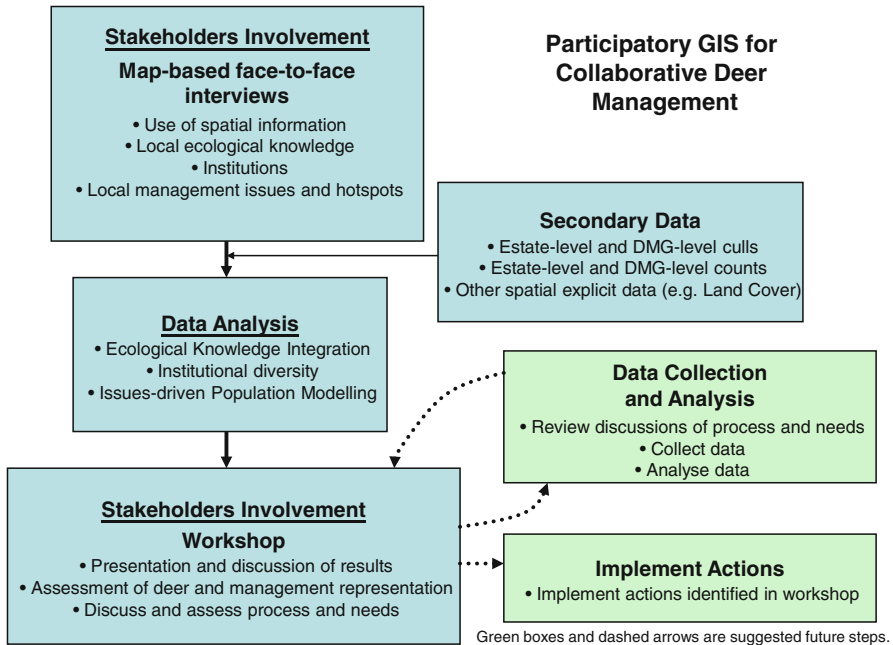


Fig. 5.2 Participatory GIS cycle

The average size of its subgroups was 4,300 ha, with a maximum of 17,700 ha and a minimum of 200 ha. The selection of the interviewees was aimed at providing wider documentation of deer management practices and objectives and covering a representative portion of the landscape included in each DMG. A total of 12 management units actively participated in the survey in BDMG, giving a representation of 74% of the area. In WSDMG, 11 management units took active part in the project, giving a representation of 67% of the DMG territory (see Irvine et al. 2009 for further discussion of the land cover in the DMGs).

Data collection consisted of an interactive process between team members and the chairmen and members of the two DMGs. Participants included both private and NGO landowners and officers of government organizations such as the Deer Commission for Scotland, which had the mandate to oversee matters related to deer management, and the Scottish Natural Heritage, which is in charge of monitoring and advising on the management of areas under various sorts of natural conservation status. The process followed the scheme illustrated in Fig. 5.2.

The first phase of stakeholders’ involvement consisted of a series of map-based, face-to-face interviews. The interviews covered four main areas: (1) the use of spatial information to document and inform management planning; (2) the local ecological knowledge on deer use of the landscape that was considered important for deer management; (3) the process followed to decide objectives for

deer management, planning, and conducting the management; and (4) the issues that affected management within and between management units with particular attention to identifying hotspots of conflict. In this phase, the interviewees also annotated maps (A1-size maps of approximately 1:25,000 scale, generated using ESRI ArcMap 9.1 with OS MasterMap as the base layer) of their management units, recording deer locations and movements in different seasons. On another map representing the outputs of a deer distribution model, the interviewees were asked to evaluate the quality of the prediction. Interviews and participant observations at DMG meetings were also conducted to document the DMG history, evolution, and working practices. In the second phase, the primary data collected were integrated with secondary data such as estate-level and DMG-level deer culls, estate-level and DMG-level counts, and other spatially explicit data (e.g., land cover) to further support analysis.

This was followed by a third phase of data analysis with three main aims: (1) integrate practitioners' and scientists' ecological knowledge to improve available models predicting deer distribution (discussed in Irvine et al. 2009), (2) describe and analyze institutional diversity in deer management (Fiorini et al. 2011 and discussed in part below), and (3) apply population modeling and deer movement modeling on contested hotspot and model alternatives to current management practices. In the fourth phase, the interdisciplinary team hosted a workshop in each DMG with the stakeholders involved in the research to discuss the outcomes of the project. During the workshops, presentations of the results were followed by discussions of their implications for management, and participants were asked to assess the deer and management representation provided by the research team. They were also asked to discuss and assess the process applied and its contribution to DMG-level management planning and implementation.

Two of the phases suggested in the proposed PGIS cycle, that is, implementation of actions and further data collection (see green boxes in Fig. 5.2), could not be conducted due to limitation of funding and the "experimental" nature of the process that did not require the participants to change management practices in response to the outcomes of the study. Data analysis applied both quantitative and qualitative techniques. Qualitative data was processed using the analysis software NVivo 8 and consisted of theme identification to allow the descriptions of the management process in decision making, identification of constraints, practices, and resources applied in management, summarizing DMG histories, and listing practitioners' ecological knowledge.

The outcome of this analysis is in part described in Sect. 5.3. I will focus particularly on various forms of local-level comanagement arrangements that developed as a response to conservation needs and pressures. Conservation and natural habitat regeneration in Scotland often requires an increase in the number of deer culled. This is considered to be damaging to the interests of those managers who rely on deer hunting as a sporting activity to supplement an estate's income or as an estate's reason to exist.

5.3 Results and Discussion

5.3.1 *Deer Commission for Scotland and DMGs: Earlier Attempts at Landscape-Level Deer Management*

Deer management in Scotland is regulated by the Deer (Scotland) Act 1996 that established the Deer Commission for Scotland (DCS). DCS had duties to “further the conservation, control and sustainable management of deer, and keep under review all matters, including their welfare, relating to deer” (Scottish Office of the UK Government 1996, part 1, paragraph 1, section a). With the Public Service Reform (Scotland) Act 2010, the power, functions, and staff of the DCS were transferred to SNH. In this chapter, I will refer to DCS because that was the organization in charge at the time of our research.

In some instances, in Scotland, legislation can very closely define deer management objectives and practice. For example, where deer are causing damage to agriculture or natural heritage, or becoming a threat to public safety on the roads, the DCS can use legislation to set control areas and define voluntary “control agreements” with land managers to reduce the impact deer are having (under section 7 of the Deer (Scotland) Act 1996). In cases where a control agreement is “not possible” or “is not being carried out,” the DCS can undertake a “control scheme” and intervene directly in culling, or otherwise removing, deer (section 8) and can even demand the expenses incurred to be refunded by the landowner (section 9). Voluntary (section 7) agreements have been the preferred approach. Direct interventions of DCS in culling deer on private estates in a couple of cases resulted in severe backlashes to its image and reputation (e.g., ERAD 2004).

As we mentioned above, DCS was instrumental in establishing the DMGs, bridging organizations whose members participate on a voluntary basis and that have represented the preferred avenue for DCS to influence local-level management. DMGs tend to have about two general meetings every year in which information relevant to the sector is shared or reported by representatives of relevant organizations, including, for example, the DCS and the Association of Deer Management Groups. Cull numbers, deer counts, and other management methods are also discussed. During these meetings, minutes are usually taken; they are distributed to the members before the following meeting.

Interviews in the two case studies reveal that the voluntary nature of DMGs promotes participation and sharing of information. At the same time, DMGs do not have the power of generating binding and enforceable agreements. This contributes to the generally shared belief that DMGs are not effective, are just an occasion for chatting without any practical consequence for management, and that what happens in the pub after the meetings is more useful than the meeting discussions. Despite this, the DMGs in the two case studies enjoy wide participation and have been active for about two decades. It is also believed that the greater the diversity of objectives

for deer management among members of the group, the less effective the DMG is. Our evidence suggests otherwise. For example, BDMG enjoyed an increase in participation after one of the large estates was acquired by an environmental NGO. In both DMGs, changes in landownership resulted in increased environmental and deer population monitoring, producing an overall increase in the knowledge available for management decisions.

Despite being a useful instrument for supporting adaptation of management systems to changing ecological and social contexts, the fact that DMGs cannot establish binding and enforceable agreements among their members has induced both governmental organizations and conservation NGOs to seek/follow other paths for achieving environmental conservation objectives. However, these strategies are often limited to estates or management units, often resulting in conflicts with management of neighboring areas. These strategies impair the development of unbounded landscape-level management of the resource deer by focusing on delimited areas and increasing conflicts at the DMG level. In Sect. 5.3.2, I will provide two examples of how conservation is implemented in two “voluntary” forms of comanagement arrangements at the management unit level.

5.3.2 Estate-Level Management

In the two case studies, priorities and objectives for deer management are generally decided among owners and their managers (i.e., estate managers, NGO officers, gamekeepers, stalkers [deer hunters], and rangers). Unless more formal (i.e., legally binding) obligations are in place with government agencies such as SNH and DCS, land managers (including NGOs) appear to be quite independent regarding decisions over what to do on their estates. Even when binding obligations are in place, the government agencies need to accept certain flexibility because resources are not sufficient to either monitor or to provide incentives nor to regulate management in the entire countryside.

There are at least two examples of how biodiversity conservation policies directly impact estates’ management. The first example consists of obligations under conservation legislation imposed through the establishment of a voluntary agreement with DCS under section 7 of the Deer (Scotland) Act 1996 and in collaboration with SNH. Biodiversity conservation policies apply to the study areas due to the presence of areas that are part of the Natura 2000 network—special areas of conservation for natural habitats and wild fauna and flora designated by European Union member states. The second example consists of conservation NGOs acquiring significant parcels of land and the associated rights to manage deer. Given the environmental objective of the NGO, it develops a “natural” alignment between government objectives and management in these areas. We will start by discussing the latter example.

5.3.2.1 Change in Landownership

In the study areas, since 1993 NGOs have been acquiring estates. This process is driven by both the opportunities offered by land reforms in Scotland and the increased buying power of NGOs for achieving conservation objectives. Acquisitions might have objectives for local economic development, as is the case in two crofters (small-scale farmers) and community buyouts we investigated under this survey, but in general, management is subordinated to the objective of the conservation organization that has control of the land. Hence, in one of the case studies, an alliance between two NGOs and a government agency aims at regenerating a large area of native woodland, and deer management plans have been developed to achieve this goal in the long term. This process, in practice, translates the guiding values and principles of the conservationists into practical deer management. In a similar way, a community buyout was particularly conditioned to achieve regeneration objectives due to the strength of conservation NGO and government representatives among its membership. These shifts in land management are perceived to have an impact on the neighbors who view the change as having a negative impact on the deer resource because of differences in how deer and natural heritage are valued.

Figures 5.3 and 5.4 show the reporting/decision structure that governs the workings of an NGO in one of the case studies and translates NGO objectives into applied management. The estate manager is the individual responsible for management. He works in close collaboration with the stalker, the shepherd, and the cattleman. The manager reports to the top-governing entity of the NGO (the board of trustees) through the Scottish operations manager, who reports to the Scottish operations director, who reports to the NGO or trust operations director, who finally reports to the board of trustees—quite a hierarchical structure. The manager and other people who work on the estate execute the mandates from the board of trustees, who, on its side, fulfills the mandates of the organization’s members. Based on the regeneration objectives of the organization and the estimated grazing impact of the deer, the managers and stalkers set the target number of deer that need to be culled each season (Fig. 5.4). This is a more simple arrangement compared to what drives culls on sporting estates.

5.3.2.2 Application of Statutory Powers

As we have briefly discussed above, the Deer (Scotland) Act 1996 gives power to DCS to enforce particular deer management objectives and practice on a private estate. Voluntary (section 7) agreements have been the preferred approach so far. Section 7 agreements are an issue in one of the case studies in which three agreements are currently in place, and others are potentially under development or may be required in the future. Some estate managers try to avoid such agreements by taking proactive steps; however, conservation areas might include more than one estate or receive pressure from deer moving in from neighboring areas. In these cases, section 7 agreements are seen by DCS as ways for developing collaborations.

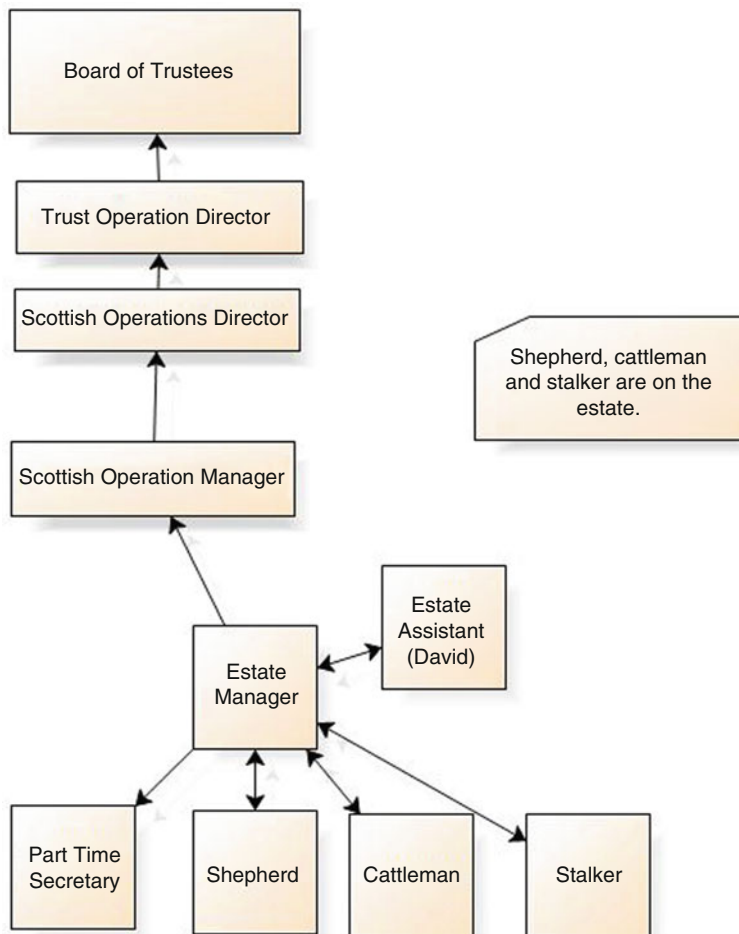


Fig. 5.3 Reporting structure on an NGO-managed property

Managers and gamekeepers traditionally set stocking rates and associated hunting/culling targets based on recruitment levels, winter mortality, and the characteristics of the individual animals they shoot. The agreements force them to adopt different targets based on habitat condition set by SNH and DCS guidelines. Disagreement over what the “right quantity” of deer is can affect the long-term effectiveness of a section 7 agreement, which is usually terminated after the habitats are deemed to be in “favorable conditions.” The causes of disagreements are likely to reside in the managers’ own experience of what grazing sustainability means, a different way of assessing environmental quality.

The views of traditional estate managers and gamekeepers can be summarized in the following quotes:

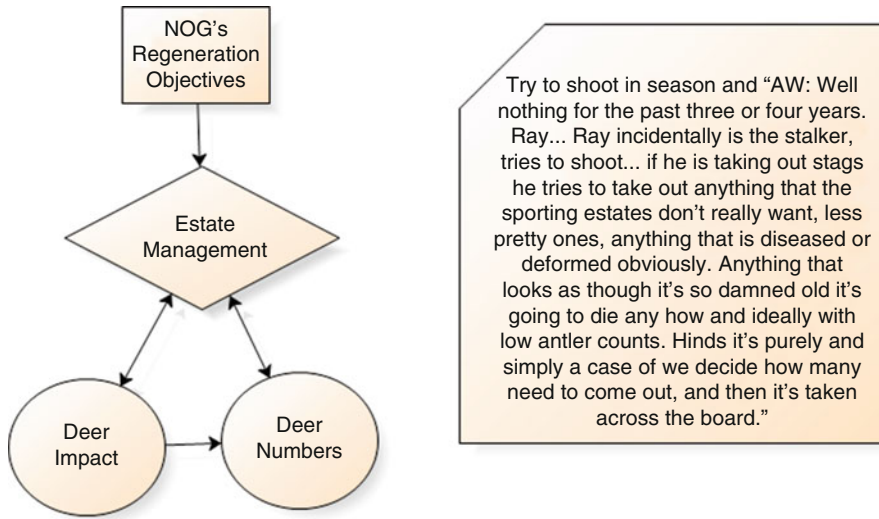


Fig. 5.4 Decision scheme on an NGO-managed property

The way I would manage them? Well as far as I am concerned the management of deer is controlling them, culling them so you have the right quantity of deer on the ground, so the habitat doesn't get destroyed As you know, if you've got too many deer, which they said [x] years ago, you do get a deterioration in the habitat At the moment, we have a reduced number of deer on the ground and we know that the habitat is improving.

I would say at the moment, maybe the deer are too low in numbers but that's [because] the SNH and DCS wanted a reduced number of deer on the ground.

We had more deer in the past so we've got a reduced number now. Personally, we had a nice number [x] years ago but of course, they said there was [sic] too many but I didn't think so. Previous to that [ten years earlier], as well as deer we had two dozen head of sheep on it and there was no complaining then. [Laughs] And you know, all these plants were still there. I'd better not say too much into there [refers to the digital recorder].

A clear demonstration of the transient impact of section 7 agreements can be seen in Fig. 5.5. Estates A and B are managed by a new organization beginning in year 7. They manage estate A for sporting income, while estate B is under a section 7 agreement. The data show that for A, there was a constant culling effort per hectare, but an increase in the proportion of males (stags) culled following the section 7 agreement in year 7. After year 7, B focused on woodland regeneration leading to increased cull efforts per hectare and an increased stag cull. C entered a section 7 agreement in year 4 and the observed increase in numbers culled per hectare is mainly due to an increase in the female (hind) cull: the result of a conservative approach to the valuable stag cull. The achievement of favorable conditions in year 9 on estate C has subsequently resulted in a decrease of the total cull mainly due to a decreased hind cull.

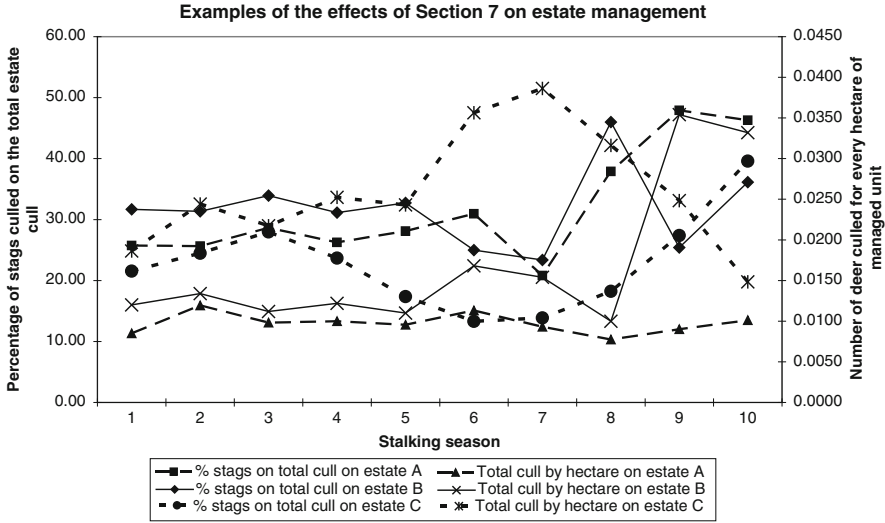


Fig. 5.5 Examples of the effects of section 7 on a private- and a community-managed estate. Deer cull figures are given as percentage of stags culled on the total cull in each estate and total deer culled by hectare. Estates A and B have been managed by the same organization since year 7. Estate B is currently affected by a section 7 agreement. Estate C is terminating a section 7 agreement that has affected its management since year 5

The impact policies have is not limited to a simple matter of deer numbers; they have wider implications for the way people relate to the land. Section 7 on estate C was imposing a different “reading” of the environment on the manager that contrasted with the manager’s own cultural perspective. Others expressed the anxiety produced by these changes in driving forces behind land management as feeling like they had been “regulated out of existence.” In the words of a crofter:

The Highlands here today, with all the stock going off the land, the deer are the only natural stock left and what worries me about the countryside today is regulating everything. It almost regulates people out of existence. You can’t do anything, you can’t be carefree today, or anything compared to my youth.

This regulating for conservation and from a distance pushes people away from the land, this same crofter told us:

Well, it is abandoning the land. The conservationists say it is putting the land back to wilderness and presumably that’s what they’d like but I don’t believe that’s a good thing. No, I don’t.

Regulation also introduces or reinforces an opposition between the local and the global. This emerged, for example, in the comments of a manager who works closely with SNH:

Our difficulties seem to occur with people higher up the chain of command, people who are less frequently out of the office and on the estate, and are much more aware and influenced by central SNH policies so they end up being less flexible.

The remoteness of the public objectives for deer management, from those involved with practical management, is perceived to go all the way to mainland Europe. This was pointed out by a couple of landowners we interviewed who complained that government organizations such as SNH and DCS were just implementing what “Brussels” wanted them to do.

5.3.3 Experimenting with PGIS

The above subsections highlighted a series of lacunae in the way adaptation of management to new needs occurs. While the DMG provides a forum for discussion, information exchange, and communication among different interest groups, its inability to produce binding and enforceable agreements, as well as the lack of effective research and analytical capabilities often results in circular discussions and conflicts based on perceptions held about the managed ecosystem. Estate/management unit-level changes are potentially associated with increases in conflicts at the DMG level or are linked to short-term and unsustainable changes in management practices.

The system currently in place is reactive to changes in policies’ objectives; when adaptation is required at the local level, it is often in order to implement or respond to external goals for deer management. In practice, there is no inclusion of local managers in the decision regarding whether change is needed or not. In other words, the current pressure for change is driven by a perceived deterioration of the environment and/or to recreate landscapes of the past (e.g., in Scotland wooded landscapes). Hence, change derives from a conception of environment and of what should drive its management, which is often foreign to those who have done it until now. Our interviewees showed us that managers have a deep knowledge and connection with the environment they manage and set their objectives and value the quality of their environment in the light of their experience and opportunity for achieving objectives defined by themselves and the landowners. Past practices and personal experience and perception of the environment play a great role in setting natural resource management objectives to produce a long-term, sustainable use of the managed resources. This is why the need to change in order to preserve an environment that has sustained certain practices for decades comes as a surprise (see the comments of the gamekeeper quoted in Sect. 5.3.2.2).

An inclusive participatory approach, aimed at effectively integrating diversity of knowledge, what Ramsey (2009) calls “diversity of problem understanding,” can provide a way forward for achieving effective adaptive management. This was in part achieved in our PGIS project. I must say “in part,” because funding and time constraints prevented the research team from taking the PGIS cycle beyond the final workshops.

After completing the first three phases of the PGIS cycle, the research team held a workshop for participants in each of the two case study areas, one in the second

half of 2008 and the other at the beginning of 2009. Hosting the workshops after the one-to-one interviews and analysis was fundamental for preventing the development of new conflicts and providing material for discussions that could bring resolutions to the then-current conflicts. During the workshops, the results of analysis, such as the one illustrated in this section, quantitative analysis of DMGs' historical culls and counts, and deer population and spatial modeling were presented. The participants—local estate managers, landowners, and representatives of DCS, SNH, and NGOs—discussed and questioned the results of the analysis. In this discussion, we noticed that conversations were less based on perceived effects of different management practices and more based on ways to improve the monitoring and analytical systems in place so that better information could be used to devise management practices that would not damage the interest of the various members of the DMG. In a sense, *the analysis grounded the discussion and social interaction on specific, practical issues related to deer and ecosystem management, moving it away from discussion driven by perceived diversity of management due to membership in a particular interest group*; discussions moved away from an interaction based on “us vs. them” to an interaction based on “how to solve or overcome differences.”

Participants were overall satisfied with the process and the outcomes and asked us for more of this kind of work. Among the points they raised and what emerged from the discussions during the workshops we find:

- The modeling tool was considered useful for predicting effects of changes in management.
- This approach could allow a meaningful discussion regarding habitat condition, moving the management away from a focus on deer number to a focus on habitat quality.
- They could see how less deer pressure can result in better hunting stocks (a change in knowledge of the ecology underlying management).
- PGIS provided the stakeholders opportunity to give their input in the process of decision making and knowledge production regarding the management of an area.
- PGIS enhanced dialogue between interest groups, for example, private estate owners/managers and government representatives, gamekeepers, and scientists.
- PGIS allowed the stakeholders to challenge the model and quality of the data, prompting discussions on monitoring needs.
- The approach to monitoring and analyzing management was considered valuable if protracted in time.
- PGIS eliminated/reduced support of perceived conflicts between management practices.

Participants also pointed out that:

- The quantitative analysis and models were based on too many assumptions.
- They would have preferred the use of a simpler language and have more explanation of concepts or representations used in the analysis.

5.4 Conclusions and Final Considerations

The analysis described above revealed how the current Scottish deer management system can potentially adapt to changes in deer management needs. However, the governance systems in place for promoting such changes can fail in their effectiveness. For example, DMGs are effective in promoting information exchange, but tend to be lacking in the means for achieving effective knowledge production, trust building, and sense making. Changes in management at the estate level tend to be short term or prone to increase conflicts between management units, increasing both social and management fragmentation at the landscape level and moving the system away from the needed, unbounded management approach discussed at the beginning of this chapter. On the other hand, the addition of PGIS to the tools available to a DMG showed that it can build and produce a collective knowledge that can be applied to enhance horizontal collaborations and support conflict resolution, contributing to the building of a long-term process of management, monitoring, and adaptation.

PGIS is a knowledge- and resource-intensive tool and that might impair the possibility of its long-term implantation in Scottish DMGs. Moreover, in this experiment, researchers assumed the role of an unaligned party, making sure that the visions, ideas, and interests of all the stakeholders involved were represented. This might not be possible when the process is coordinated by someone with, or perceived to have, a vested interest in the outcome of the process.

As the final consideration, PGIS enhanced the horizontal social and cultural interactions needed to expand management adaptation at the landscape level but did not enhance a similar interaction along the vertical axis (i.e., from the local to the regional, national, and international levels). In the end, the participants in this study were asked to incorporate (or had to deal with) objectives for deer management that were guided by models of conservation foreign to their culture and emerging from a different relationship with nature, the environment, and the local context. PGIS, in a sense, was able to facilitate the identification of the “how to change” management, rather than enhance collaboration on deciding the “why change is needed.” In short, what kind of participatory approach would allow a meaningful vertical participation in the management of our natural resources?

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