**Landscape level management case studies for ecological, economic and social outcomes: lessons learned**

**Research briefing RD1.4.3aD6**

Authors: Macleod C.J.A,\* K. Blackstock, G. Begg, A. Eastwood, A. Fischer, P. Lackova, L. Kuhfuss, O. Shortall and A. Vinten

\*Corresponding author: [[kit.macleod@hutton.ac.uk]](mailto:kit.macleod@hutton.ac.uk)

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# Executive summary

Improving the management of Scotland’s natural assets at a landscape level for ecological, economic and social outcomes is a priority for the Scottish Government and partners. Adaptive management is one way to achieve this objective, and is about connecting the ‘doing’ of natural resource management with ‘learning’ about the context of the management situation, and the responses and effects of the management actions. In a previous briefing we provided an overview of the concept of adaptive management and its practical management in the Scottish context. Previous studies have highlighted that the implementation of adaptive management has been challenging for many stakeholders. Therefore, this briefing focusses on lessons learnt to support Scottish stakeholders who wish to take a more adaptive approach to managing at the landscape scale in partnership with others.

Learning from our five landscape level cases, which span a range of natural resource management situations in Scotland, we have made 14 recommendations (Table 1) based on the context, participants and purpose; the process of doing landscape level management; and the need to plan for social and ecological outcomes. We believe the diversity of our cases suggest that these recommendations are relevant for most landscape level cases in Scotland and potentially internationally, seeking to adapt and learn (Figure 1). Our findings are based on interviews and workshops with natural and social science researchers involved with these cases.

Our four main conclusions are:

1. when supporting or implementing landscape level management changes for ecological, economic and social outcomes then careful understanding of the context, participants and purpose is needed before moving to the next step of planning activities;
2. adaptive management to deal with uncertainty in socio-ecological systems is pertinent to cases across a wide range of Scottish landscape level issues, and the main barriers to adaptive management tended to be socio-economic rather than lack of scientific knowledge;
3. learning takes place across every step of the adaptive management cycle and not just wait until there are ecological outcomes to assess; and
4. that social processes are at the heart of effective and efficient landscape level management.

Figure 1 Steps and recommendations for adaptive management at the landscape level

A screenshot of a cell phone

Description automatically generated

Table 1 Recommendations when considering landscape level management.

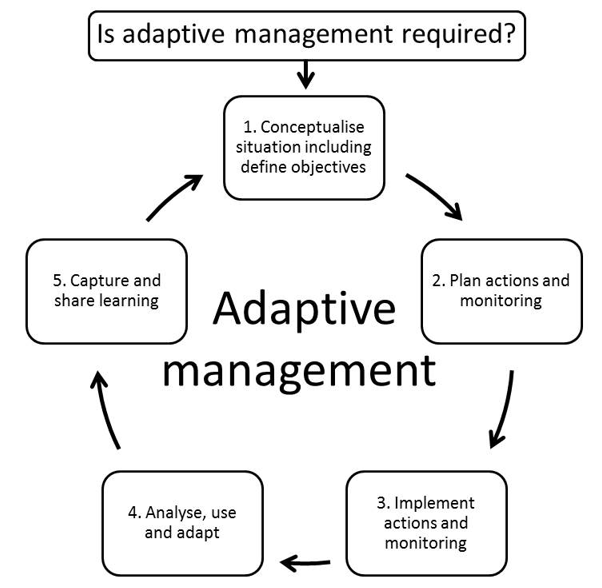
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| --- |
| **1.Understand the context, stakeholders and shared purpose**  Expect to spend significant time and resources understanding the context, identifying and engaging possible direct stakeholders and agreeing a shared purpose before any work ‘on the ground’ can start. |
| **1.1 Shared understanding of the context**  When starting to plan landscape level adaptive management, consider what the landscape comprises in terms of diverse ownership and management arrangements, and establish a shared understanding of the current condition of the natural assets. |
| **1.2 Identify and understand the direct decision-making stakeholders**  Try and understand the main decision-making stakeholders from their perspective in terms of their objectives and preferences, before trying to agree a shared purpose and how the purpose may be achieved. |
| **1.3 Identify and agree the shared purpose**  Problem framing is not always self-evident, and it can take time to develop a shared purpose.If there is no existing shared problem framing and purpose, then more time and resources (including time and resources for facilitation) may be needed to develop a shared purpose. |
| **2.Focus on the social processes of landscape level management**  The social processes of adaptive management at the landscape level are closely connected to achieving successful ecological outcomes and therefore social processes needs explicit planning, support and resources. |
| **2.1 Identify and support local leaders**  Depending on the purpose and context, careful consideration is needed of who takes leading roles and how leadership can be supported and sustained over time. |
| **2.2 Identify and secure human and financial resources**  Landscape level adaptive management will require human and financial resources for the interventions but also for the processes of coordination or collaboration; and these resources may need to be long term if the collective action is needed for several years to ensure social and ecological outcomes. |
| **2.3 Understand the influence of national organisations**  There is a need to understand how national organisational objectives and remits (even when not directly involved) may influence adaptive management processes. |
| **2.4 Understand the influence of indirect stakeholders**  In addition to identifying and working with direct stakeholders (3.1.2) and national organisations (3.2.3), it is important to take account of indirect stakeholders, including public opinion, and how these can influence the appetite for and success of adaptive management. |
| **2.5 Understand the role of collaborative data collection and knowledge sharing**  Whilst collaborative data collection is important, a landscape level adaptive management process need to consider how data will be used, and by whom for what purpose. Improving how knowledge is generated, collectively interpreted and shared is likely to improve the adaptive management processes. |
| **3.Plan for social and ecological outcomes at every step**  As learning takes place across every step of the adaptive management cycle, it is important to monitor the whole socio-ecological system, analyse and reflect on learning throughout the learning cycle and not just wait until there are ecological outcomes to assess. |
| **3.1 Think and plan for long-term interventions and their legacies**  Supporting landscape level management needs to recognise the long-term nature of the management actions and their legacies, and plan for long-term interventions even when funding is short-term. Thinking long-term should not preclude regular reviews of purpose and process. |
| **3.2 Distinguish between coordination and collaboration**  It is important not to conflate landscape level interventions with collaboration; but to recognise when adaptive management occurs through coordination and when it is collaboration and support accordingly. |
| **3.3 Recognise what has or may change as part of the learning process**  Ensure that all changes, whether positive or negative, intended or unintended, are captured and learnt from. Any learning also needs to recognise when changes have not or will not occur in the current circumstances. |

# 1. Introduction, purpose and audience

Learning how to manage Scotland’s natural assets at a landscape level for ecological, economic and social outcomes is a priority for the Scottish Government and partners, as reinforced in the second Land Use Strategy ([Scottish Government, 2016](#_ENREF_6)). Adaptive management is one way to achieve this objective; where adaptive management is a structured and systematic approach to supporting decision making, planning, action and evaluation of those actions (Figure 1). Adaptive management is about connecting the ‘doing’ of natural resource management with ‘learning’ about the context of a management situation, and the ecological, economic and social outcomes of the management actions. Adaptive management can be undertaken within a property (areas managed by a single individual or organisation) and is increasingly used to intervene at a ‘landscape’ level involving multiple properties and social actors. In this research, we have focused on landscape level management of natural assets across multiple properties and involving multiple actors.

A previous review of approaches to adaptive management for specific species ([Bunnefeld *et al.*, 2015](#_ENREF_1)) highlighted that the implementation of adaptive management had been challenging for stakeholders. In their report, the authors suggested a checklist before engaging in adaptive management: is it appropriate, is it feasible, and can it be successful? Taking an adaptive management approach is appropriate when understood as a process of learning and improving understanding through monitoring actions taken on the ground. This briefing extends the provision of support to stakeholders to help them to put adaptive management into practice in Scotland at the landscape level. When adaptive management is applied to complex socio-ecological systems, such as multifunctional landscapes, social and institutional learning, and how the range of interactions between different actors, networks, organisations and institutions develop and adapt in pursuit of desired goals, become very important.

Figure 1. Steps in a classic adaptive management approach (from Macleod et al 2016b).



In our initial briefing ‘Adaptive management: an overview of the concept and its practical application in the Scottish context’ we highlighted the importance of the first key question ‘is adaptive management required?’ ([Macleod *et al.*, 2016b](#_ENREF_4)). We suggested that a set of principles were needed to implement a set of five steps (Figure 1): involve stakeholders, develop and cultivate partnerships, embrace learning, document your decisions, and adjust as necessary. For example, to implement landscape level management, it is important to iterate through the adaptive management cycle (Figure 1) and document the learning at each stage.

## 1.1 Purpose and audience

The purpose of this briefing is to provide practical insights to support stakeholders interested in implementing landscape level management for ecological, economic and social outcomes. This research briefing summarises lessons learned from five ongoing case studies utilising landscape level management of natural resources for ecological, economic and social outcomes. We present our findings and recommendations to enable greater shared understanding of what needs to be considered when implementing or supporting landscape level adaptive management. In short, this briefing illustrates what additional issues need to be considered when working adaptively at a landscape level with multiple actors.

These case studies are from research projects funded through the Scottish Government Strategic Research Programme’s (SRP) work package ‘Integrated and Sustainable Management of Natural Assets’ (WP1.4) which is addressing the question ‘how can we support delivery of multiple benefits in practice’? Our findings are determined by the nature of these cases, and the questions we explored with the researchers involved in each case (Appendix 1).

We envisage the audience for this research briefing to include a broad range of policy makers and practitioners e.g. Scottish Natural Heritage (SNH), Scottish Environment Protection Agency (SEPA), National Park Authority (NPA) staff, non-governmental organizations (NGO) e.g. Royal Society for the Protection of Birds (RSPB), and relevant membership associations e.g. National Farmers Union, Scotland (NFUS) and Scottish Land & Estates (SL&E). These organisations have a shared interest in understanding and supporting collective management of Scotland’s natural assets at the landscape level. These national and regional organisations have an important influence on the implementation of adaptive management in Scotland, even when they are not directly involved in the projects themselves. This briefing may also be useful to those actually involved in collective landscape level management – for example, using the recommendations in sections 3 and 4 as a checklist for their projects.

# 2. Case study research process

The five cases cover a range of landscape level management situations, including upland and lowland areas. These vary from improving agricultural land management in a small east coast catchment (3500 ha) to the management of White-tailed eagles over large areas of the west coast including Argyll & Lochaber and Skye & Lochalsh. The five cases are summarised in Table 1 and further information on where the cases are located, the collective grouping and background to the landscape level management is provided in Appendix 2.

Table 2 illustrates the research steps carried out to produce this briefing and how this built on earlier briefings: a review of adaptive management and its practical application in the Scottish context ([Macleod *et al.*, 2016b](#_ENREF_4)); draft adaptive management evaluation framework ([Macleod *et al.*, 2016a](#_ENREF_3)); and a summary of our landscape level cases ([Macleod *et al.*, 2018](#_ENREF_2)).

Table 1. Summaries of the case contexts: what landscapes, who and when.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **Balruddery** | **Cairngorms Connect** | **East Cairngorms Moorland Partnership** | **Lunan** | **White-tailed eagle** |
| **Approximate area (ha)** | 3500 | 60000 | 100000 | 13400 | Argyll & Lochaber; Skye & Lochalsh;  100000s |
| **Land cover/ use** | Arable with some soft fruit and livestock. | Moorland, native woodland, coniferous forestry, sporting and tourism. | Moorland, native woodland, coniferous forestry, sporting and tourism. | Arable with some horticulture and livestock. | Hill sheep farming, commercial forestry, and tourism. |
| **Who involved** | 12 farms (tenanted and owners; Forestry Commission own one). | Five estates owning around eight land parcels (private, RSPB and others). | Six estates (private and NGO- National Trust; Crown Estates). | Four riparian owners directly involved (three private and one NGO) and others involved in catchment partnership. | Organizations, crofts, farms and forestry owners represented (on the National Sea Eagle Stakeholder Group and wider partnership). |
| **Start** | Started in 2016. Evolution of Hutton agro-ecological work since ~2008. | Started ~2016.  Evolution of NGO and public bodies and transformation of one private estate’s mission. | Started~2014.  Evolution of CNPA objectives. | Started in 2016.  Evolution of Hutton catchment work since 2005. | Started in 2014.  Evolution to deal with conflict following from reintroductions in 1975. |
| **Timescale** | Annual cropping to five year focus for farm management (incl. AECS grant cycle). | Vision 200 years. | Vision five years or longer. | 25 years. | Action Plan (2017 – 2020) with further 15 years management plan proposals. |

Many of these cases do not label themselves explicitly as an ‘adaptive management’ case. However, they share many of the characteristics of adaptive management, as these cases have set out on processes of collective learning regarding how to best manage their natural assets. Adaptive management is about the process of managing change: understanding why change is occurring, and the people and resources involved in enabling (or resisting) change. Furthermore, these cases share common characteristics around land use or land management change; and all involve multiple stakeholders and the use of learning to improve practices. In these cases, a range of approaches were attempted to initiate and support landscape level management (and governance). In two of our cases, researchers were the primary driving force behind the proposed management interventions (Balruddery and Lunan) and in the other three cases the researchers were observing management interventions implemented by other individuals and organisations. All cases started the adaptive management cycle (Figure 1) relatively recently and are generally at stage 2 (planning) or stage 3 (implementation) rather than having completed a cycle, let alone undertaken multiple learning cycles. However, all cases are building on longer term shared knowledge of natural asset management. This combination of similarities and differences provides a fruitful way to consider common lessons learnt for the use of adaptive management in Scotland at the landscape level.

Table 2. Summary of the research steps leading to this briefing.

|  |  |  |
| --- | --- | --- |
| **What** | **How** | **When** |
| Engaged with researchers studying landscape level management. | Individual researchers in the five cases, observed or directed landscape level management and co-developed our methodology. | 2016- |
| Review of practical adaptive management and draft evaluation framework. | Summarised adaptive (co-) management (and governance) research and practice. | 2016-  2017 |
| Co-production of interview questions with research and non-research stakeholders. | Researcher workshop and stakeholder feedback on case summaries. | July-December 2018 |
| Interviews with researchers (natural and social science perspectives[[1]](#footnote-1)). | Recorded semi-structured interviews with researchers involved in each case (Appendix 1 contains questions asked). | March- May 2019 |
| Comparative analysis using framework approach. | Transcripts analysed using NVivo12:  coded by three researchers using deductive node structure; framework approach to compare the results using two researchers (not the interviewer); and peer review of the findings by the co-authors in a research workshop. | September- November 2019 |
| Draft policy briefing for policy and management stakeholders. | Drafted and shared with stakeholders (involved in setting interview questions). | December 2019- |

# 3. Lessons learnt (findings and recommendations)

In all our cases there was a desire for landscape level approaches to managing natural assets for multiple ecological, economic and social outcomes. Reflecting on our structured analysis of interviews and workshops (Table 3), we placed our findings in three groups: the first covers understanding the ‘context, participants and purpose’; the second focuses on the ‘process of landscape level management’; and the third reflects the need to ‘plan for social and ecological outcomes at every step’ that were, or will be, achieved in these cases. Within each recommendation group, the main findings are summarised followed by the recommendation arising.

## 3.1 Understanding the context, stakeholders and shared purpose

Although Figure 1 already recognised the importance of asking ‘is adaptive management appropriate’ and then contextualising the situation, our research suggests that taking time to establish a shared understanding of the context – including legacies of previous land use, interventions and policies - to carefully identify the direct decision-making stakeholders and to build a shared understanding of the purpose is extremely important. Implementing these recommendations can be quite time-consuming and resource intensive, however this investment can minimise inaction or conflict later. We found a great deal of learning takes place at this step and can help achieve social and ecological outcomes.

**Recommendation**: Expect to spend significant time and resources understanding the context, identifying and engaging possible direct stakeholders and agreeing a shared purpose before any work ‘on the ground’ can start.

### 3.1.1 Shared understanding of the context

The spatial scale of landscapes in our cases varied tremendously (Table 1); in all our cases landscape level management was characterised by working across land ownership boundaries, involving multiple types of land managers (public sector, NGO or private) and often involving heterogenous land cover and use within a single case. For example, our cases varied from arable dominated catchments on the east coast that included four to 12 land managers discussing a new practice, to groups of five to six upland estates discussing new practices in the Cairngorms National Park - covering tens to hundreds of thousands of hectares. In some cases, there were differences in how people perceived the condition of the natural assets. Therefore, establishing a ‘baseline’ is not only about having data on the state of the environment pre-intervention, but understanding how the historical intertwining of land use, environmental conditions and governance shapes different stakeholders’ perspectives on natural assets and how they should be managed.

**Recommendation:** When starting to plan landscape level adaptive management, consider what the landscape comprises in terms of diverse ownership and management arrangements, and establish a shared understanding of the current condition of the natural assets.

### 3.1.2 Identify and understand the direct decision-making stakeholders

Partners may collaborate around a shared landscape level project but can still have diverse objectives, and are affected by how their natural assets are currently (and historically) managed and governed. In our cases, the land managers in the east coast catchments were similar farm businesses with a varied range of land and water management objectives; however, some land was also owned or managed by NGOs or the public sector. Our upland cases in the Cairngorms, included an assortment of land managers and a variety of decision-making arrangements including single tenants, boards, families and trusts. The White-tailed eagle case, involved large numbers of public and private actors covering multiple sectors including forestry, farming and tourism.

**Recommendation:** Try and understand the main decision-making stakeholders from their perspective in terms of their objectives and preferences, before trying to agree a shared purpose and how the purpose may be achieved.

### 3.1.3 Identify and agree the shared purpose

Adaptive management at the landscape level needs common shared issue framing and objective setting. Though all cases were motivated to improve the current situation (including improving the state of land, water and biodiversity) using specific interventions, there was not always consensus on the problem, for example, balancing the need to understand and reduce predation on livestock with maintaining the conservation status of White-tailed eagle populations. Consensus was also lacking with some proposed interventions, such as in the Lunan case. Cases with externally initiated interventions were more contested than those who self-identified problems and had a vision for their initiative, for example Cairngorms Connect have a shared long-term vision of supporting habitat regeneration processes. In other cases, there has been limited action due to time spent trying to agree how to intervene, for example in the Lunan case and in the East Cairngorms Moorland Partnership.

**Recommendation:** Problem framing is not always self-evident, and it can take time to develop a shared purpose.If there is no existing shared problem framing and purpose, then more time and resources (including time and resources for facilitation) may be needed to develop a shared purpose.

## 3.2 Focus on the social processes of landscape level management

The idea of process draws attention to the tasks of planning, implementing and analysing interventions to improve the management of natural assets in our cases. Although the idea of ‘process’ – planning, doing and reflecting, is at the heart of adaptive management, our findings suggest that data collection, analysis and knowledge generation is just one of a number of social processes, many of which relate to the complex governance landscapes within which our cases were situated. This group of recommendations related to social processes considers the influence of leadership, the influence of regional and national stakeholders, the influence of indirect stakeholders, the importance of human and financial resources, and the role of data and knowledge within adaptive management. Overall, our findings suggest that when working at a landscape level, involving multiple stakeholders, the social processes of how individuals and organisations relate and work together, and how these are influenced by stakeholders not directly involved in landscape interventions, needs to be given more attention. As with the context, participants and purpose, it is important to document and learn about the processes involved, even before there are changes in the ecological condition of natural assets. Explicit attention to understanding these social processes is fundamental to adaptive management and which social factors facilitate positive ecological outcomes.

**Recommendation:** The social processes of adaptive management at the landscape level are closely connected to achieving successful ecological outcomes and therefore social processes needs explicit planning, support and resources.

### 3.2.1 Identify and support local leaders

The dynamism of the landscape level management in our cases was influenced by who was leading it. These cases included examples of coordination being supported by dedicated staff in the East Cairngorms Moorland Partnership and White-tailed eagle cases, and by research organisation staff in the Balruddery and Lunan cases. In the Cairngorms Connect case, there was no dedicated project officer initially, but staff time was made available to the project due to organisational commitments to a shared collaborative vision. In at least one of our cases e.g. White-tailed eagle, then charismatic and trusted leaders from the partners including SNH and the land management community were key to the success of implementing the management activities. However, if a trusted leader steps away from a process, this can have an effect e.g. paused activities until they are replaced appropriately. Changes in leadership can provide opportunities for reflection and learning e.g. the formation of a new Skye Sea eagle management group with a wider representation of interest groups.

**Recommendation:** Depending on the purpose and context, careful consideration is needed of who takes leading roles and how leadership can be supported and sustained over time.

### 3.2.2 Identify and secure human and financial resources

Whilst land managers can, and do, undertake environmental improvements without incentives, action at a landscape level across multiple property boundaries tends to require human and financial resources. In our cases we found a range of approaches to resourcing landscape level management from encouraging collaborations to financially supporting a coordinator or providing contractors to collect data or undertake the interventions. In most cases, support for the intervention was increased when aligned with economic incentives via the Scottish Rural Development Programme, private investment, research grants and potential payments for ecosystem services. For example, Cairngorms Connect’s activities can now accelerate as they have won a large grant for restoration conservation. Resources are not just about finance for actions, for example, farmers in Balruddery benefitted from help with their Agri-Environment Climate Scheme applications. However, there is a mismatch between the time taken to achieve the desired ecological outcomes and availability of funding, which is often on an annual to five-year cycle.

**Recommendation**: Landscape level adaptive management will require human and financial resources for the interventions but also for the processes of coordination or collaboration; and these resources may need to be long term if the collective action is needed for several years to ensure social and ecological outcomes.

### 3.2.3 Understand the influence of national organisations

National organisations associated with the cases had an important influence on the adaptive management processes. Beyond being associated with the provision of resources for coordination and/or interventions as noted in 3.2.2 above, these organisations implement national or EU policy (public sector) or national objectives (NGOs or corporations). For example, national level organisations (SEPA and SNH) were found to both positively and negatively influence the process of agreeing on the management intervention in the Lunan catchment. On the one hand, officers supported and advocated the intervention, but land managers were also wary of these agencies due to ongoing disputes about flood management practices in the wider region. In the White-tailed eagle, Cairngorms Connect and East Cairngorms Moorland Partnership cases, some of the NGOs had to reconcile national priorities with the specific needs of the partnerships.

**Recommendation:** There is a need to understand how national organisational objectives and remits (even when not directly involved) may influence adaptive management processes.

### 3.2.4 Understand the influence of indirect stakeholders

Indirect stakeholders such as local and national interest groups and local communities can influence the purpose, process and outcomes of the management interventions. We found that government policy and wider public opinion (including national campaigning organisations) was mentioned in all cases, for example changing views on the roles of land managers to provide public goods for public financial support or changing public attitudes to field sports. This influenced why individuals and organisations felt the need to work collectively to manage their natural assets; and also meant more attention was being paid to making their actions visible to others. For example, whilst the interventions in Balruddery were extremely localised (field margins to provide habitat for invertebrates) the actions were also responding to global issues like the climate emergency and the biodiversity crisis. In the Lunan catchment, a governance gap was a barrier to implementing the solution i.e. it was unclear which individuals or organisations would be responsible for its long-term management.

**Recommendation:** In addition to identifying and working with direct stakeholders (3.1.2) and national organisations (3.2.3), it is important to take account of indirect stakeholders, including public opinion, and how these can influence the appetite for and success of adaptive management.

### 3.2.5 Understand the role of collaborative data collection and knowledge sharing

The collection of data through monitoring is integral to adaptive management in order to analyse and adapt (step 4 in Figure 1) and to learn (step 5 in Figure 1). Our findings suggest that we need to understand data and knowledge beyond just considering what is collected, but also think about how the data is collected, by whom, how it is understood, how it is shared and how it is used to improve shared understanding of the system.

In all our cases monitoring and data sharing was judged to be important. For example, maps of the Balruddery catchment, including information on existing environmental state, stimulated interest from the land managers. In the White-tailed eagle case, the monitor farms were fundamental to improving understanding of current predation levels and the potential effectiveness of management actions. In the Lunan, a shared model of how water moves through the catchment seemed to increase acceptance of the proposed intervention. However, data alone was not sufficient, in each case it was important to have social processes that improve collective understanding of the system through collaborative monitoring that allowed data to be interpreted and discussed, and to combine scientific knowledge with local and experiential knowledge from land managers.

**Recommendation:** Whilst collaborative data collection is important, a landscape level adaptive management process need to consider how data will be used, and by whom for what purpose. Improving how knowledge is generated, collectively interpreted and shared is likely to improve the adaptive management processes.

## 3.3 Plan for social and ecological outcomes at every step

Figure 1 doesn’t explicitly mention outcomes, but steps 4 and 5 imply that some results have been achieved and reflection is taking place to see if these results have generated the ecological, economic and social outcomes desired when the cycle began at step 1 (see 3.1.3 on shared purpose above). In our cases there was limited evidence of changes in desired ecological outcomes that the projects set out to achieve. This was due to a range of reasons; partly, the cases were about reversing long term environmental trends and so the outcomes may take years or decades to be realised. Furthermore, due to issues around participation, purpose and process, some cases had not actually implemented many changes required in order to achieve the planned ecological outcomes. However, what was more apparent were the social outcomes that were necessary to enable longer term ecological outcomes, as well as being an end result in themselves. Therefore, this section is structured in terms of how cases planned for the long-term, the need to distinguish between coordination and collaboration, and recognise what has or may change as part of the learning process. Overall, the findings suggest that learning and reflection should take place at every step of the cycle, not just at step 5 (see Figure 1 above).

**Recommendation:** As learning takes place across every step of the adaptive management cycle, it is important to monitor the whole socio-ecological system, analyse and reflect on learning throughout the learning cycle and not just wait until there are ecological outcomes to assess.

### 3.3.1 Think and plan for long-term interventions and their legacies

In all our cases landscape level management was viewed as a long-term social process. In some cases, this was seen as an enabler e.g. long-term vision of Cairngorms Connect encouraged a commitment to a project where results might not be seen for over a decade. However, in others, the uncertainty associated with sustaining commitment for many years was a barrier e.g. lack of suitable long-term institutional arrangement for the proposed weir in the Lunan catchment. Recognising, and planning for, how to support interventions over the longer term is an important social outcome in itself. However, it is important that the cases remain adaptive and revisit their purpose periodically, as context and participants evolve, and lessons are learnt from the processes.

**Recommendation:** Supporting landscape level management needs to recognise the long-term nature of the management actions and their legacies, and plan for long-term interventions even when funding is short-term. Thinking long-term should not preclude regular reviews of purpose and process.

### 3.3.2 Distinguish between coordination and collaboration

One of the aspects our cases illustrated was an important difference between collaborative arrangements, whereby individuals voluntarily worked together collectively to implement actions; and coordinated arrangements, whereby landscape level interventions are achieved, but mainly through a coordinator working one-to-one with the natural asset managers in the relevant area. More of our cases appeared to be coordinated action (e.g. East Cairngorms Moorland Partnership) than collaborative action (e.g. Cairngorms Connect), although it seems that coordination can build interest and momentum that may evolve into more of a collaborative process (e.g. in Balruddery). In general, employing a paid coordinator is more resource-intensive and less resilient as it relies on the coordinator, but it is possibly the most appropriate option when initiating complex landscape level interventions with diverse participants and contested objectives.

**Recommendation:** It is important not to conflate landscape level interventions with collaboration; but to recognise when adaptive management occurs through coordination and when it is collaboration and support accordingly.

### 3.3.3 Recognise what has or may change as part of the learning process

Understanding adaptive management is being open to what may and what has changed, in terms of social and ecological outcomes. There is already evidence of habitat restoration outcomes in Cairngorms Connect and increased understanding of interactions between livestock and White-tailed eagle predation, whilst within the Balruddery catchment, there was increased uptake of agri-environmental measures and the potential to join a carbon-offsetting scheme. However, the Lunan and East Cairngorms Moorland Partnership cases have seen less changes due to contested ideas about what needs to change and how, for example in the Lunan there was much more understanding of land and water issues- if not agreement on the solutions. In some cases, individuals chose not to adapt their land use or land management to provide a wider range of outcomes, which makes implementing adaptive management difficult, but is still an outcome and something to learn from.

**Recommendation**: Ensure that all changes, whether positive or negative, intended or unintended, are captured and learnt from. Any learning also needs to recognise when changes have not or will not occur in the current circumstances.

# 4. Concluding discussion

We have presented 14 recommendations spanning understanding the context, participants and purpose; the importance of the social processes of doing landscape level management; and the need to plan for social and ecological outcomes at every step (Table 3). We believe the diversity of our cases suggest that these recommendations are relevant for most landscape level cases in Scotland, seeking to adapt and learn in order to improve the quality and extent of their natural assets, to support sustainable land-based industries and vibrant communities.

Our four main conclusions are, first when supporting or implementing landscape level management changes for ecological, economic and social outcomes (that differs from existing management practices and norms) then careful understanding the context, participants and purpose is needed before moving to the next step of adaptive management and initiating further discussions and planning activities. This suggests that the question ‘is adaptive management appropriate?’ is relevant for landscape level interventions not just for species ([Bunnefeld](#_ENREF_1" \o "Bunnefeld, 2015 #13821) *[et al.](#_ENREF_1" \o "Bunnefeld, 2015 #13821)*[, 2015](#_ENREF_1" \o "Bunnefeld, 2015 #13821)) and that the first step of the cycle (Figure 1) needs to be extended to make understanding the context, stakeholders and shared purpose more explicit.

Our second conclusion is that adaptive management to deal with uncertainty in dynamic socio-ecological systems is pertinent to cases across a wide range of Scottish landscape level management issues, and the main barriers to adaptive management tended to be socio-economic e.g. access to long-term funding or acceptance of the intervention rather than lack of scientific knowledge. Data and knowledge were essential to our cases, but as part of the wider social learning dynamics of the processes, not as stand-alone inputs to the process.

Our third conclusion is that as learning takes place across every step of the adaptive management cycle. Therefore, more attention needs to be put on how data and knowledge is used at every step of the cycle (see Figure 1) including recording and analysing social variables, and not just wait until there are ecological outcomes to assess.

Our fourth is that ‘process’ is at the heart of effective and efficient landscape level management. In the extensive adaptive (co-) management (and governance) literatures (see ([Macleod *et al.*, 2016b](#_ENREF_4)) for a summary) the importance of social process to landscape management is widely acknowledged. For example, the importance of social process in relation to explaining outcomes (over half of results and a third of ecological effect variability) has been shown for four biosphere reserves (two in Canada and two in Sweden) ([Plummer *et al.*, 2017](#_ENREF_5)). However, there is less evidence that this finding has permeated into policy and practice in Scotland, hence this briefing to make it more explicit and provide practical guidance on how to achieve this.

Therefore, the initial Adaptive Management cycle (Figure 1) (simplified to plan – implement - learn) and set of principles (Section 1.), typically implemented by one actor on one site, has been adapted to indicate the additional steps to consider when implementing adaptive management at the landscape scale with multiple actors (see Figure 2). Including the principle to record decisions and learning at each step.

Figure 2. Steps and recommendations for adaptive management at the landscape level.

A screenshot of a cell phone

Description automatically generated

Table 3 Recommendations when considering landscape level management.

|  |
| --- |
| **1.Understand the context, stakeholders and shared purpose**  Expect to spend significant time and resources understanding the context, identifying and engaging possible direct stakeholders and agreeing a shared purpose before any work ‘on the ground’ can start. |
| **1.1 Shared understanding of the context**  When starting to plan landscape level adaptive management, consider what the landscape comprises in terms of diverse ownership and management arrangements, and establish a shared understanding of the current condition of the natural assets. |
| **1.2 Identify and understand the direct decision-making stakeholders**  Try and understand the main decision-making stakeholders from their perspective in terms of their objectives and preferences, before trying to agree a shared purpose and how the purpose may be achieved. |
| **1.3 Identify and agree the shared purpose**  Problem framing is not always self-evident, and it can take time to develop a shared purpose.If there is no existing shared problem framing and purpose, then more time and resources (including time and resources for facilitation) may be needed to develop a shared purpose. |
| **2.Focus on the social processes of landscape level management**  The social processes of adaptive management at the landscape level are closely connected to achieving successful ecological outcomes and therefore social processes needs explicit planning, support and resources. |
| **2.1 Identify and support local leaders**  Depending on the purpose and context, careful consideration is needed of who takes leading roles and how leadership can be supported and sustained over time. |
| **2.2 Identify and secure human and financial resources**  Landscape level adaptive management will require human and financial resources for the interventions but also for the processes of coordination or collaboration; and these resources may need to be long term if the collective action is needed for several years to ensure social and ecological outcomes. |
| **2.3 Understand the influence of national organisations**  There is a need to understand how national organisational objectives and remits (even when not directly involved) may influence adaptive management processes. |
| **2.4 Understand the influence of indirect stakeholders**  In addition to identifying and working with direct stakeholders (3.1.2) and national organisations (3.2.3), it is important to take account of indirect stakeholders, including public opinion, and how these can influence the appetite for and success of adaptive management. |
| **2.5 Understand the role of collaborative data collection and knowledge sharing**  Whilst collaborative data collection is important, a landscape level adaptive management process need to consider how data will be used, and by whom for what purpose. Improving how knowledge is generated, collectively interpreted and shared is likely to improve the adaptive management processes. |
| **3.Plan for social and ecological outcomes at every step**  As learning takes place across every step of the adaptive management cycle, it is important to monitor the whole socio-ecological system, analyse and reflect on learning throughout the learning cycle and not just wait until there are ecological outcomes to assess. |
| **3.1 Think and plan for long-term interventions and their legacies**  Supporting landscape level management needs to recognise the long-term nature of the management actions and their legacies, and plan for long-term interventions even when funding is short-term. Thinking long-term should not preclude regular reviews of purpose and process. |
| **3.2 Distinguish between coordination and collaboration**  It is important not to conflate landscape level interventions with collaboration; but to recognise when adaptive management occurs through coordination and when it is collaboration and support accordingly. |
| **3.3 Recognise what has or may change as part of the learning process**  Ensure that all changes, whether positive or negative, intended or unintended, are captured and learnt from. Any learning also needs to recognise when changes have not or will not occur in the current circumstances. |

# 5. Next steps

This briefing will be circulated to relevant audiences as described in section 1.2 for feedback and then the updated briefing will be used to inform those involved in, or supporting, landscape level projects across Scotland. If resources allow, we will develop our recommendations into an opinion pieces in a scientific journal to ensure that our findings are shared with the international community working on adaptive (co-) management (and governance).

# Acknowledgements

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# Appendix 1: Interview guide and questions

As part of our Scottish Government research on landscape level collective arrangements for the management of natural assets for ecological, economic and social outcomes, we are interviewing researchers leading a series of case studies:

* Cairngorms Connect
* East Cairngorms Moorland Partnership
* [Balruddery Sustainable Catchment Programme](#_Toc518308538)
* [Lunan – water for all project](#_Toc518308541)
* White-tailed Eagle Action Plan

In each case, we are interviewing at least one Hutton researcher from SEGS and one from a natural science group (EBS or ES). These questions will enable us to provide a synthesis of findings from these cases related to landscape level adaptive management of natural assets. In the interviews we plan to explore a series of questions about the planned outcomes and process of change.

To ensure that views are accurately captured, we would like to record the interview. If you prefer not to be recorded, please tell me now and I will take fieldnotes. You can request a copy of the notes or transcript for checking if you wish, but I will not send them out without your request to reduce your workload. Because those interviewed will also be contributing to the analysis and writing up of the material, we have not utilised a conventional research ethics process. However, the interview process will still adhere to standard social research ethics, namely:

* You understand the purpose of the study and can ask questions about your participation
* Your contributions – such as ideas and information collected during interviews – will be used to inform the WP1.4.3a research project and subsequent outputs.
* Your participation in the interviews is voluntary and you can withdraw at any time without suffering personal consequences
* The interview voice recording and transcription will be stored in a secure folder that is only available to members of 1.4.3a research team in compliance with the 95/46/EC Directive and EU regulation 2016/679 – GDPR
* Whilst your identity will be accessible due to authorship on outputs arising, individual points will not be directly attributable to any individual, unless you agree to this during the analysis and writing stage.
* By allowing the interview to proceed, I indicate my agreement with the above points and consent to take part.

Q1) What are the characteristics of the case (their biophysical setting, main land use activities, location)?

Q2a) What change(s) are involved in terms of both processes and outcomes?

Q2b) What types of change have taken place?

Q3a) Who is involved in these landscape scale initiatives?

Q3b) What role do they play in deciding whether change is desired and setting the objectives?

Q4a) Who is leading the initiative?

Q4b) How did they come to lead?

Q4c) What is the role of the researcher in this context?

Q5a) What interaction does this case have with national and regional institutions (e.g. policies, market drivers and public opinion)?

Q5b) To what extent are existing institutions driving change or constraining the options for change?

Q6a) How was the group able (or not) to adaptively manage the situation?

Q6b) Did change occur or is it likely to do so? Have the desired outcomes been achieved or are likely to be achieved? Why or why not?

# Appendix 2: Brief summaries of the case studies

These summaries focus on the characteristics of the cases, including: the collective grouping and the changes taking place.

## 3.1 Balruddery Sustainable Catchment Programme

##### Summary of the case

This case study is exploring the potential for collaboration between farmers within the catchment to improve the effectiveness of agri-environmental management.

A large green field

Description generated with very high confidence

Figure 3: A view over the Balruddery catchment

##### Where is the case located (and size)?

##### The Balruddery Catchment is an area of approximately 3500 ha situated to the west of Dundee City on the north of the River Tay. It extends to about 12 km from WNW – ESE and 3 km in a NNE – SSW direction (Figure 3).

##### What is the collective grouping related to the case?

An informal group of neighbouring farmers that has the general purpose of gaining and sharing knowledge about each other’s practices and that of the James Hutton Institute Balruddery Research Farm which lies at the geographical centre of the catchment.

##### What is the background to the landscape level collective arrangements for multiple benefits?

Unlike the above cases, there are no explicit collective arrangements already in place. However, the motivation is to share experiences and gain insight from the activities of the James Hutton Institutes’ Balruddery Research Farm and the work of the institute more generally. The Balruddery Sustainable Catchment Programme was initiated by Graham Begg, and Euan Caldwell was instrumental in engaging with neighbouring farmers to create the farmer group.

## 3.2 Cairngorms Connect

##### Summary of the case

This case study is based on Cairngorms Connect: a voluntary partnership between neighbouring land managers; Glenfeshie Estate (WildLand Ltd), Inshriach (FCS), Invereshie & Inshriach (SNH), Rothiemurchus (FCS), Glenmore (FCS) and Abernethy (RSPB) (Figure 1). The case study is part of a wider research project which explores what influences bring about changes in management, and what impacts formal and informal collective arrangements have on landscape level management and its adaptation to change.

A field with a mountain in the background

Description generated with very high confidence

Figure 1: Natural regeneration at Abernethy National Nature Reserve

##### Where is the case located (and size)?

In the Cairngorms National Park, covering an area of approximately 60000 ha. It contains the largest remnant of ancient Caledonian pinewood forest in the UK.

##### What is the collective grouping related to the case?

The collective grouping is a mixture of both private landowners and managers (Wildland Ltd), public (Forestry Commission Scotland, Scottish Natural Heritage) and non-governmental organisation (Royal Society for the Protection of Birds) partners.

##### What is the background to the landscape level collective arrangements for multiple benefits?

It was formally established in 2016 by like-minded land managers and owners with a common goal to enhance and improve the condition of the species, habitats and ecological processes across their estates/properties. Their long-term restoration plans are aimed at the landscape scale, connecting different ecosystems and processes to deliver multiple benefits including flood regulation, carbon storage and recreation.

## 3.3 East Cairngorms Moorland Partnership

##### Summary of the case

This case study is based around a group of private, public and non-governmental organisation owned estates in the Cairngorms National Park including Mar Lodge (National Trust for Scotland), Mar, Invercauld, Balmoral, Glenavon and Glenlivet (Crown Estates Scotland) (Figure 2). This case study is part of a research project which explores what influences bring about changes in management, and what impacts formal and informal collective arrangements or groups may have on landscape level management and its adaptation to change.

A large green field

Description generated with very high confidence

Figure 2: Glen Geldie in Mar Lodge Estate

##### Where is the case located (and size)?

The case in located in the Cairngorms National Park. Altogether, the six estates cover around 100000 ha.

##### What is the collective grouping related to the case?

The main objective of the partnership is to showcase best practice moorland management across a landscape, whilst recognising the different management objectives of different estates and a need to maintain viability of estate enterprises (i.e. grouse and deer shooting).

##### What is the background to the landscape level collective arrangements for multiple benefits?

##### The East Cairngorms Moorland Partnership was initiated by Cairngorms National Park Authority to develop (and try to influence) best practice examples of moorland management in the national park. Their main objectives are to enhance wood expansion, restore peatland, conserve raptors and other priority species, and enhance the landscape. The partnership aims to deliver across a landscape and number of private and public benefits.

## 3.4 Lunan – Water for all Project

##### Summary of the case

##### This case is based on a research project that aimed to introduce a new water management scheme to provide multiple benefits in the catchment area. These benefits were to improve water quality to protect biodiversity in wetlands, reduce flood risks and improve water availability for irrigation. This scheme required collaboration and agreement amongst the multiple stakeholders (riparian owners, farmers and their representatives, conservation agencies looking after the wetlands, rivers trust concerned with fisheries, local council responsible for flood management) around the installation/modification of hydraulic structures and their funding and management. It also required ongoing development of a catchment scale hydraulic model of the impact of management on flows.

Figure 4: A view over the Lunan catchment

##### Where is the case located (and size)?

##### This case is in the Lunan Water catchment area, between Montrose and Forfar in Angus, Eastern Scotland, UK. The Lunan Water drains an intensively farmed mixed arable catchment of 13400 hafrom its source near Forfar to the Lunan Bay (Figure 4).

##### What is the collective grouping related to the case?

A Lunan Water Catchment Management Group was set up in April 2016 to provide steering and oversight to the project, as well as to highlight any other catchment issues in need of consideration. This was chaired by the local authority (Angus Council) and members included the main regulatory bodies (Scottish Environment Protection Agency, Scottish National Heritage) and local interest groups (Balgavies Loch Committee, Scottish Wildlife Trust, Esk Rivers and Fisheries Trust) and members of the water for all research team.

##### What is the background to the landscape level collective arrangements for multiple benefits?

The main leaders of this project are the James Hutton Institute, with a focus on research, Angus council with an interest in flood management and Scottish Natural Heritage with an input into wetland conservation. The Lunan Water Catchment Management Group meets two to three times per year to discuss and guide progress on the project development and adaptation. A survey was carried out to assess local attitudes and willingness to pay for innovative water management as well as preferences for the governance model.

## 3.5 White-tailed Eagle Action Plan

##### Summary of the case

##### The case is based around a national partnership that implements adaptive management through the White-tailed Eagle Action Plan (2017 – 2020) in a long-term conflict around the re-introduction of White-tailed eagle and sheep farming.

##### Where is the case located (and size)?

The case is located on the west coast of Scotland, covering parts of the Highlands and Islands region. The current management is focused in the areas of Skye and Lochalsh, and Argyll (and the Isle of Mull) and Lochaber. Additional cases in the Western Isles and in Wester Ross are being integrated in the management scheme, although no separate management groups have been established.

Figure 5: White-tailed Eagles

##### What is the collective grouping related to the case?

##### At a national level, the Scottish Natural Heritage (SNH) coordinates The National Sea Eagle Stakeholder Group that comprises representatives from Royal Society for the Protection of Birds (RSPB), National Farmers Union of Scotland (NFUS), Scottish Crofting Federation (SCF), Forestry Commission Scotland (FCS), Scottish Government Rural Payments and Inspections Division (SGRPID), and Scotland’s Rural College (SRUC). At a local level, two stakeholder groups were set up in Argyll and Lochaber and Skye and Lochalsh. The local groups comprise of representatives from farming and crofting communities and from the organisations in the national group.

##### What is the background to the landscape level collective arrangements for multiple benefits?

The partnership in the case study was established in 2014 to manage an escalating conflict over white-tailed eagle predation of sheep, with wider discussions on the legitimacy of re-introductions. The National Sea Eagle Stakeholder Group developed a national strategy, the White-tailed Eagle Action Plan (2017 – 2020), to establish management objectives that would deliver sustained co-existence between white-tailed eagle conservation and sheep farming. At a local level, stakeholder groups oversee the implementation of the Sea Eagle Management Scheme (2015-2019) that supports measures to mitigate against eagle predation impacts, while also trialling management alternatives in line with goals set in the action plan.

1. Due to illness, the WTE case only involved social science perspectives. [↑](#footnote-ref-1)