Forest Research

Land management planning in West Sutherland

West Sutherland, in northwest Scotland, is a remote area characterised by its dramatic landscapes, expansive vistas and world-renowned geology. Forestry and Land Scotland's (FLS) **West Sutherland Land Management Plan** (LMP) covers an area of 6684 ha of FLS land, of which 2877 ha are afforested, primarily with Sitka spruce and Lodgepole pine planted as no-thin mixtures in the 1960s to 1980s. The forest lies along the River Oykel, which is internationally recognised for fishing and is a designated Special Area of Conservation (SAC).

Management objectives

The forest is managed for multiple objectives, including conservation of globally significant protected freshwater species and habitats, informal recreation and timber production. The restoration of blanket bog and limestone-derived open habitats, to enhance the aquatic habitats and landscapes and mitigate climate change, are recent priorities. A key objective is to create resilient ecosystems that provide benefits for current and future generations and retain the flexibility to cope with an uncertain future.

Risks and opportunities

Main climate change risks

There are four main climate change risks relevant to management. Firstly, a projected increase in storm frequency and wind speeds in winter months. Secondly, changes in seasonal rainfall, with wetter winters. Thirdly, projected hotter, drier summers increasing the wildfire risk, and lastly milder winters with a lower incidence of frosts, which is associated with an increase in the likelihood of and susceptibility to tree pests and pathogens.

Vulnerabilities

An increase in storm frequency and wind speeds, combined with wetter winters, un-thinned stands and wet soils restricting rooting depth, will increase the risk of windthrow, with some stands already affected. Heavy rainfall will increase the risk of soil erosion, peat slides, silt movement and soil carbon release, where the historical drainage patterns are unable to cope. The increased turbidity can have negative impacts on sensitive freshwater ecosystems.

Find detailed information in UKFS Practice Guide *Adapting forest and woodland management to the changing climate*.

Information on the UK Forestry Standard and supporting guidance is available at www.forestresearch.gov.uk/ukfs

Hotter, drier summers combined with increasing visitor numbers brings a greater risk of wildfire; 30 ha were lost to fire in 2016. An increase in drought occurrence will increase stress to trees.

Lodgepole pine is already affected by *Dothistroma* needle blight (DNB), demonstrating that reliance on two main tree species has increased stand vulnerability to pests and diseases. There are high numbers of the large pine weevil (*Hylobius abietis*), which can cause seedling mortality, due to extensive clear-fells driven by DNB and windthrow. Milder winters may allow pest and pathogen populations to increase, which would previously have been reduced by prolonged cold periods.

Identifying and selecting measures

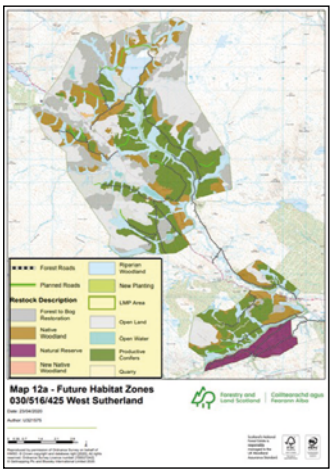
The new West Sutherland LMP is a significant departure from the business-as-usual approach, drawing on the expertise of the National Planning team, Forest Research and external stakeholders to produce a plan that has climate resilience and biodiversity conservation as its core themes. The landscape changes proposed are significant in scale because they shift focus from influencing site conditions to working with natural processes. They aim to sustainably deliver a wide range of ecosystems services and public benefits.

Peatland restoration is a key measure for climate change mitigation. First rotation conifers will continue to be removed from selected peatland sites, as determined by habitat type, hydrological connectivity or predicted greenhouse gas balance. **Blocking drainage channels** protects the peat and can help improve water quality.

Species diversification is an essential strategy to increase resilience. Suitable sites will be restocked with a mixture of site-native broadleaf pioneer species to increase species diversity and diversify the forest structure, increasing resilience to windthrow and pest and pathogen outbreaks. Wide (30 m) broadleaf riparian woodland buffers will be created to benefit the freshwater environment. Large areas of native woodland will be created on the montane ecotone after poorly performing conifer crops have been harvested. This will help to address biodiversity declines and maintain forest cover to reduce flooding.

Natural regeneration will be used in the Caledonian Forest Reserve. Increased vegetation layers will help slow surface run-off and filter water during heavy rain. Increased woody debris should support invertebrate populations.

Conifers will be planted in areas where there is lower wind risk using the **Detailed Aspect Method of Scoring** (DAMS<18) to provide timber for the forestry sector, and will be thinned to manage risk as climate and terrain allows; the **ForestGALES decision-support tool** is used to assess risk and inform management. Conifer areas will include a minimum proportion of 20% of broadleaf species to increase diversity and improve soils, reducing the need for inorganic fertiliser. Retention of these broadleaves at clear-fell will preserve mycorrhizae for the next rotation and provide a valuable seed source. The new woodland has been designed with smaller coupe sizes, keeping clear-fell areas below 25 ha to reduce the impacts on hydrology and water chemistry and increase structural diversity.



Land Management Plan future habitat zones.

Implementing adaptation measures

Adaptation has begun and will be ongoing for many decades to come. Surveys have been carried out to identify continuous, hydrologically connected bogs to direct future restoration. There has been initial **restoration** of approximately 700 ha of peatland has taken place since 2014, using the latest fibre recovery and hydrology restoration techniques developed on the National Forest Estate in Caithness and Sutherland, with a further 1400 ha planned. The first areas of riparian woodland have been established in partnerships with the Kyle of Sutherland Fishery Board and Trust using EU LIFE funding from the **Pearls in Peril** programme. Five-year fallow periods are necessary to reduce high *H. abietis* population levels and protect seedlings, while also minimising the use of insecticide.

A view across the West Sutherland LMP area

Monitoring and assessment

Many of the planned measures are innovative, in keeping with the approach that we will 'learn by doing'. This means there are ongoing questions, for example, the short-term implications for the freshwater ecosystem is less certain.

Long-term monitoring is essential to inform future decision-making and partnership opportunities will be explored. **A Forest Research study** at Stratheskie Burn is assessing the effects of mulching as a peatland restoration technique on this tributary of the Oykel SAC. This study has been running since 2015 and is now investigating the effects of novel restoration techniques such as ground smoothing on water quality.

Regional staff will monitor and review the work to see how marginal sites are best managed for the changing climate by using species diversity and soil conservation.

Lessons learnt

We have experienced benefits in creating wide riparian woodland buffer areas, including improved water quality and habitat diversity. However, there are knowledge gaps about the impacts of forest management on carbon sequestration for an LMP area.

Monitoring is expensive but essential, and a partnership approach is best to spread this load. Research partnerships can play an essential part in adaptive management by sharing results with partners who will use findings to inform management.

Intended future outcomes

Our vision for West Sutherland is of a structurally diverse forest within wide landscapes of restored habitats. The restored peatland sites and bogs will be functioning naturally, and Sphagnum mosses will have colonised. The drainage patterns of the mid-20th century will be gone, and the forest will be better adapted to the wetter winters and windier climate. More than 750 ha of riparian woodland will be established along the watercourses, providing shade, habitat and improving water quality. This riparian network, combined with wider areas of birch forests, will provide a permanent structure, within which areas of productive woodland can flourish. The well-established monitoring programmes will inform the next generation of foresters and ecologists about the impacts of our land management changes.

This case study is one of a number supporting the UKFS Practice Guide on *Adapting forest and woodland management to the changing climate*

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