



Glen Creran Woods

**Exploring the perceived
impacts of different management
interventions on woodland benefits**



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The James
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Institute



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Background

Forests are an important part of Scotland's natural heritage and can provide a number of benefits to people, such as natural flood management. The type of benefits a forest delivers depends on the way it is managed and used. In addition, different people will perceive benefits differently and have different preferences. To understand how these factors are interconnected, the James Hutton Institute is conducting a research project looking at forests in different parts of Scotland. One of our study areas are the woodlands in Glen Creran, Argyll. Here in this report we specifically look at Glen Creran woods, a Site of Special Scientific Interest managed by the Forestry Commission Scotland (FCS). Within this study area we also plan to explore the Glasdrum Wood National Nature Reserve, managed by Scottish Natural Heritage. The other study areas are Mar Lodge (Cairngorms) and the woodlands in and around Cumbernauld (North Lanarkshire).

To measure the perceived benefits from different management interventions and explore the differences in people's preferences, we chose a methodology which we refer to here as *scenario workshops*. This entails developing illustrative future management scenarios which form the basis of discussions about the management and use of the woodland. For Glen Creran Woods, researchers at the James Hutton Institute developed, together with Donald McNeill and Susannah Hughes from FCS, six scenarios as written narratives (Appendix 1). These build on documents such as management plans, surveys

and future predictions on climate and its impact. The six narratives were supplemented by 3D visualisations at key viewpoints in the woodland. One of the scenarios was based on the past (The Early 1980s), one on the present (The Present 2018) and the other four were future scenarios set in the year 2035. The four hypothetical future scenarios were based on i) the current FCS management plan (which we termed Rainforest Beginnings), ii) a strong emphasis on biodiversity and conservation (The Lynx Returns), iii) a focus on community engagement (Fairies and Fun), and iv) a final scenario, Successful Exotics, based around a scenario where budgets are very low and only management interventions required to fulfil minimum statutory requirement are carried out.

The Local Expert Panel Methodology

A local expert panel was assembled for a one-day facilitated workshop in April 2018. The panel comprised seven local experts from different backgrounds, professions and perspectives. These local experts were sent the six narratives a week before the workshop. Following an information session and explanation of methodology, participants were asked to individually score

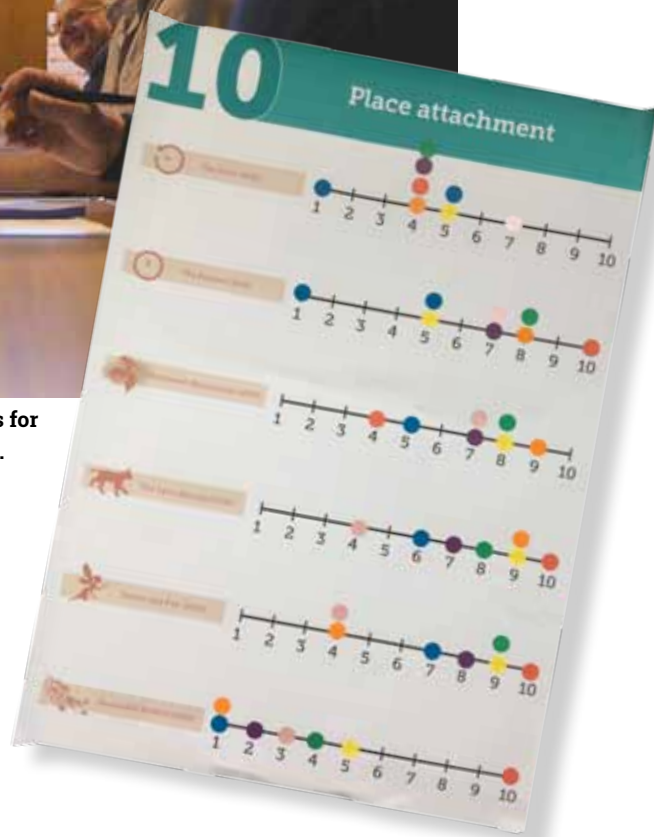
(from 1-10) how well they thought each scenario performed against 11 ecosystem service (benefit) indicators (see Appendix 2 for full description of the indicators). Participants were also asked to indicate how confident (low, medium, high) they felt about their scores.

Following the scoring exercise, the scores were displayed visually around the room for all the six scenarios, across the 11 indicators. Each expert's scores were represented using a different coloured dot. A facilitated discussion followed, to explore patterns, differences and similarities in the scores for different scenarios across indicators and individuals. For example, did any scenarios score particularly well across all indicators? How did scores for any particular indicator vary depending on scenario? And what were the reasons behind any differences between individual scores?

Following the first deliberation session, participants were given an opportunity to revise their individual scores if they wished. Panel members were then asked to choose their favourite scenario, explaining why they made this choice, and what improvements or changes they would make to it.



Graphic representation of scores for the indicator 'Place Attachment'.



Results from the scoring exercise

Table 1 illustrates the median values of the six scenarios across the eleven indicators. Overall four of the scenarios (The Present 2018, Rainforest Beginnings, The Lynx Returns and Fairies and Fun) were perceived as performing reasonably across all the indicators (Median of Medians = 7). The Lynx Returns had the highest median value (9) for Landscape Quality and Character, but was not considered to perform very well for Employment and Income (3) nor Timber

Extraction (3). The reason provided for the low scores was the loss of jobs in the timber industry, should this scenario become reality. The Early 1980s and Successful Exotics performed least well across the majority of indicators, although they did score reasonably well for Carbon Stored (5.5 and 6.5) and Natural Flood Management (both 6). Successful Exotics scored poorly (1) for suppressing the invasive exotic rhododendron as well as other target species such as brambles and bracken.

Table 1: Median values of the scenarios across the 11 indicators (where 1 is low and 10 is high). See Appendix 2 for the full description of each indicator.

	Early 1980s	Present	Rainforest Beginnings	Lynx Returns	Fairies & Fun	Successful Exotics
Employment	4	6	4	3	7	2
Target Species A	3	5	5	7	7	2
Target Species B	3	7	4	6	5	1
Timber Extraction	4	6	4	3	5	2
Carbon Stored	5.5	6.5	7.5	7	5	6.5
Mental Restoration	4	7	8	8	8	4
Spirituality	4	8	7	8	5	5
Learning	3	6	7	6	8	2
Landscape Quality	4	7	8	9	7	3
Place Attachment	4	7	7	8	8	3
Natural Flood Management	6	7	7	7	4	6
Median of Medians	4	7	7	7	7	3

Figure 1 shows a summary of the scores as box-plots for the six scenarios across the 11 indicators. The horizontal line in the middle of each box is the median or middle score.

One of the most notable features of the plots is the breadth of variation between the scores assigned by the expert panel members indicating a wide range of opinion (or disagreement). For example, for Spirituality under the Fairies and Fun scenario, scores ranged from a maximum of 10 to a minimum of 2. Similarly there was also a lot of variation in Spirituality in the Successful Exotics scenario. For some panel members the different types of management interventions would not impact on those less tangible benefits such as Mental Restoration, Spirituality or Place Attachment. As one participant said *"I don't really think if there's an abundance of brambles, it's going to alter how I feel about the glen"*. However, for others the different types of management interventions or lack of management did have a perceived impact on those less tangible benefits. Spirituality showed

less variation in The Present 2018 scenario and Rainforest Beginnings.

Scores also varied considerably around the median, with sometimes large differences between the lower and upper quartiles (long boxes). This can be seen in the Natural Flood Management indicator, where the variation around the median was high (long boxes) for all the scenarios. During the discussion the panel demonstrated different opinions on the importance of flooding in Glen Creran, depending on their own personal experiences. Another panellist found this indicator difficult to score. This may explain the diversity of scores for Natural Flood Management. Another panellist struggled to score Carbon Stored, expressing that they knew nothing about it. While others also found the Carbon Stored indicator difficult, one of the panellists noted that the scores for Carbon Stored did not show that much variation across participants as well as across scenarios. It may be that people just said *"I've no idea, I'll give it six, and I'll keep it at six"*, as one of the panellists

suspected. Another panellist felt that carbon storage would indeed remain relatively stable across the different scenarios. The confidence scores for Carbon Stored were low or medium.

The Present 2018 scenario appeared to show least variation around the median, although some participants still expressed a very different opinion from the rest. This is not too surprising, as this would be the scenario the panellists could more easily relate to, rather than imagine into the future.

Despite the large variation between some individual scores, the management intervention in the scenarios The Present 2018, Rainforest Beginnings, The Lynx Returns and Fairies and Fun were perceived to deliver multiple benefits, and with a few exceptions, scored high for Mental Restoration, Spirituality (with the exception of Fairies and Fun), and Landscape Quality and Character.

Key discussion points from group deliberation

Access, local residents and visitors

One major challenge raised was the limitations of the woodland site to cope with increased numbers of visitors as envisaged in the Fairies and Fun scenario. The site is linear, with a single track road and small car park at the end, and participants felt that the potential increase in traffic would be detrimental to local residents. A suggested potential solution was to improve the parking facilities at Glasdrum Wood and add a connecting footpath up the glen towards Glen Creran woods.

Some panel members also felt that the additional pathways and visitors featured in the Fairies and Fun scenario could negatively impact on the Mental Restoration, Spirituality and Place Attachment of local residents, as the solitude and 'specialness' of the place would be lost. However, participants also acknowledged that whilst Mental Restoration and Place Attachment may decrease for some local residents, larger numbers of people would benefit from visiting the glen and experiencing the woodland themselves. Other panel members said they enjoyed people visiting the glen (*"I don't mind seeing people in the glen, it's good, it's life, it's good"*) and did not feel that increased visitor numbers or improved access would impact on people's mental restoration or spirituality. They argued that the glen offered lots of scope and there was something for everyone, and felt that there was *"the opportunity to climb higher up the hill if you want to"*.

Access to the woodland was also discussed in relation to the Successful Exotics scenario, where loss of access due to *"a take-over of invasives"* meant that no-one, neither locals

nor visitors, would be able to enjoy the woods. If very few people came up the glen, one panellist commented *"you'd feel out on a limb, and you'd feel, ... do you want to be in this backwater anymore?"* Another panel member reminisced about the time (The Early 1980s) when access was less formal *"as a local person you would know where the informal routes were; the deer routes and the badger routes, and you know, [...] it was lovely because you had the sense of exploring, every time you went up you'd see something new"*.

Reintroductions, native, non-native and invasive species

Although The Lynx Returns scenario performed relatively high in the scoring exercise (see Table 1), some members of the panel had strong reservations with one aspect of the scenario in particular; the re-introduction of lynx to the glen. One panellist felt that *"it [lynx] was got rid of for a reason"*. The panel generally did not feel that Glen Creran was remote enough or large enough to support lynx. Another participant expressed the need to be cautious with re-introductions, as species can quickly become a nuisance to landowners and so need careful management. Others were more supportive of reintroductions in general, and felt that appropriate management approaches can mitigate any damage or loss to farmers. One participant also wondered if having lynx in the glen could potentially increase the sense of place for visitors: *"If that happened, it creates more of a sense of place because Glen Creran is the place where there are lynx, so for people who don't live here, it would give this place more of a sense of identity"*.

The panel greatly appreciated the concerted efforts made by the FCS and the community to remove invasive rhododendron from the site, and generally approved of felling exotic conifer species and encouraging native woodland in the glen. One panellist commented that although the felling and invasive species removal was initially detrimental to the site (making it look *"like a battle site"*), with time and sensitive management, things would improve. Another panellist lamented the felling of the conifers at the start of the pine marten trail: *"It was magical at that point, the whole path was just lime green, it was the most magical one. And they devastated it"*.

Not all non-native species were unpopular. Several panellists discussed their fondness for the veteran non-native species in the glen such as beech, the *Wellingtonia* and *Radiata* pine specimens. The beech trees above Lochside Cottage were described as *"beautiful"*, *"a spiritual place"*, *"lovely"* and that to remove them for *"purist reasons would be crazy"*, *"a sacrilege"*. Some of the very big old Sitka spruce are being colonised by

Figure 1. A summary of the scores as box-plots for the six scenarios across the 11 indicators. The horizontal line in the middle of each box is the median or middle score. The top line of the box represents the 75th percentile (upper quartile) and the bottom line the 25th percentile (lower quartile). The long 'whiskers' emerging for the boxes represent the maximum and minimum scores. Points outside the whiskers are outliers or observations numerically distant from the rest of the data. See Appendix 2 for full description of indicators.

Legend

- | | | |
|--------------------------------|-----------------------------------|-------------------------------------------------------|
| Employment and Income | Target Species A – Spring Flowers | Target Species B – brambles, bracken and rhododendron |
| Timber Extraction | Carbon Stored | Mental Restoration |
| Learning, Knowledge and Skills | Landscape Quality and Character | Spirituality |
| | | Place Attachment |
| | | Natural Flood Management |

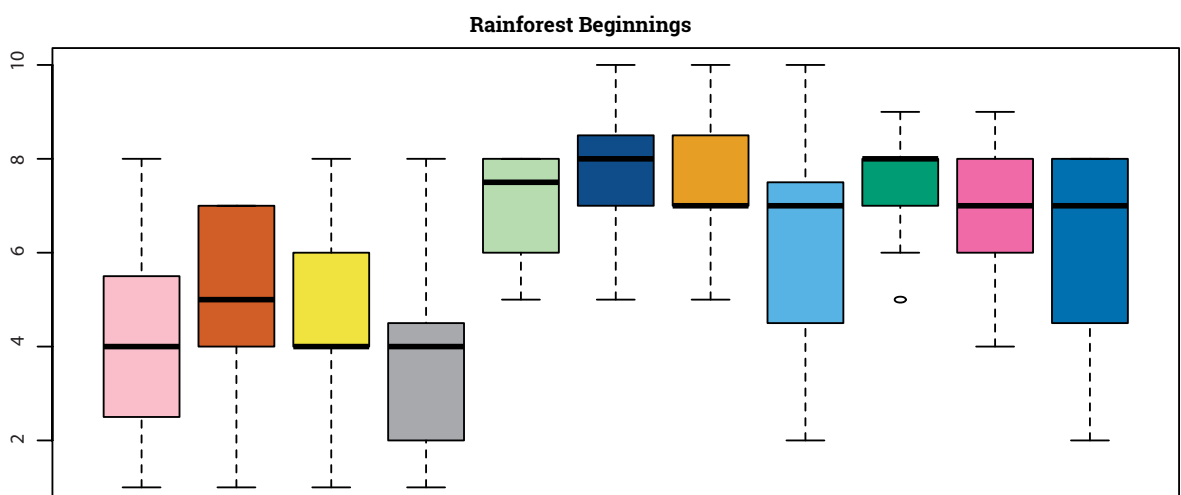
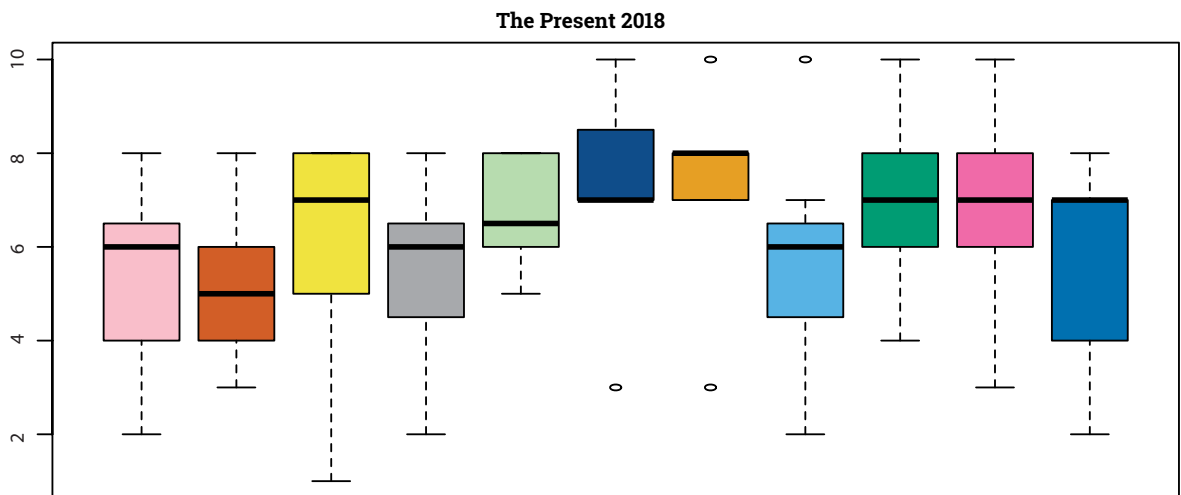
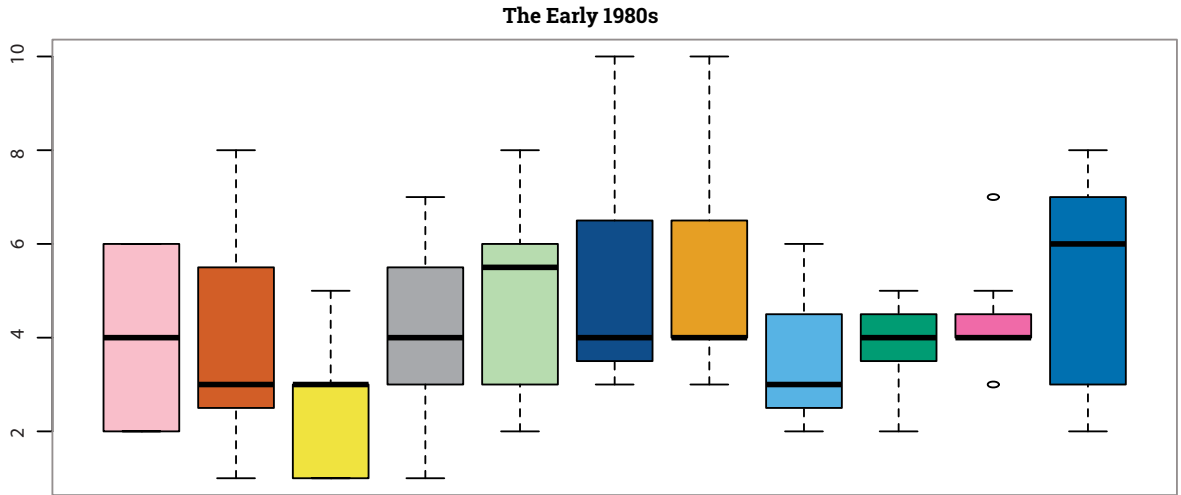
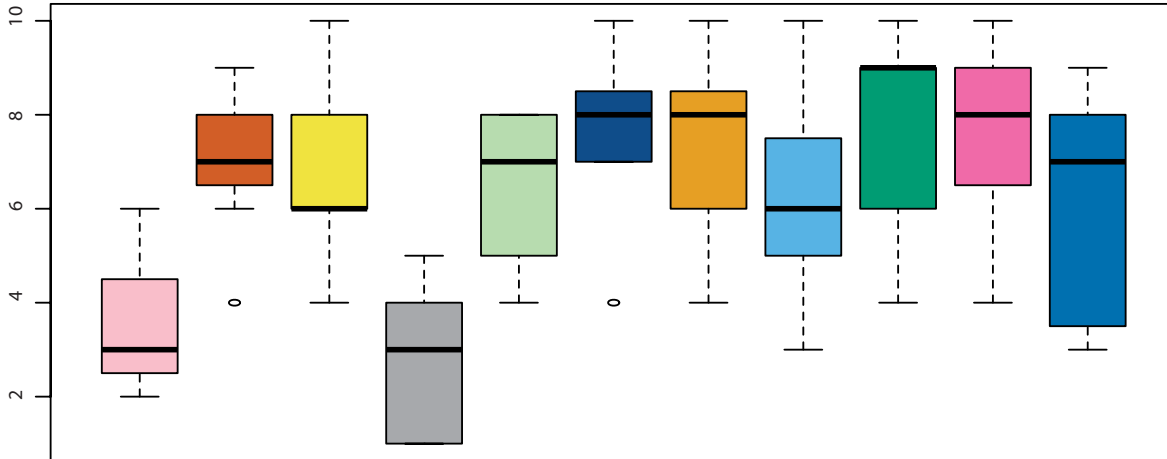


Figure 1. Continued.

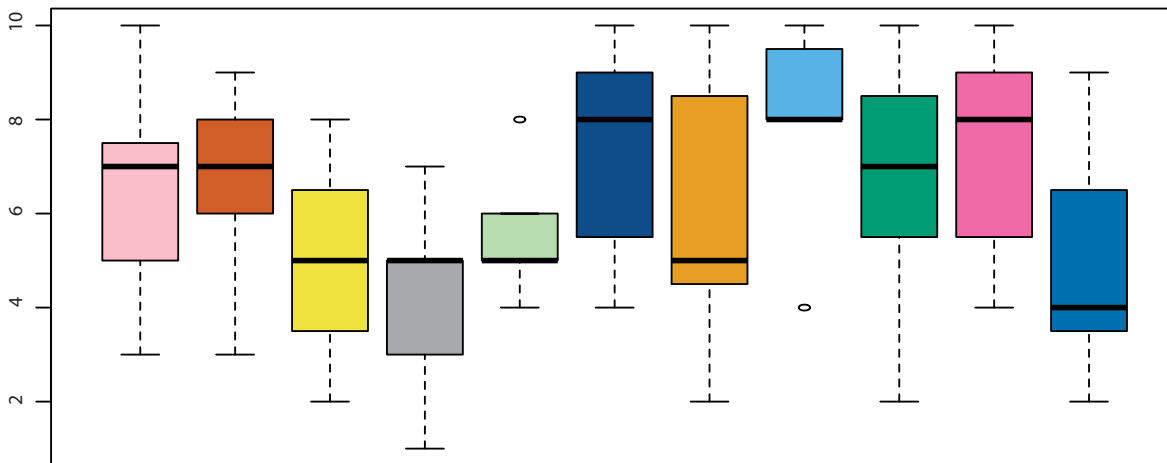
Legend

- Employment and Income
- Target Species A – Spring Flowers
- Target Species B – brambles, bracken and rhododendron
- Timber Extraction
- Carbon Stored
- Mental Restoration
- Spirituality
- Learning, Knowledge and Skills
- Landscape Quality and Character
- Place Attachment
- Natural Flood Management

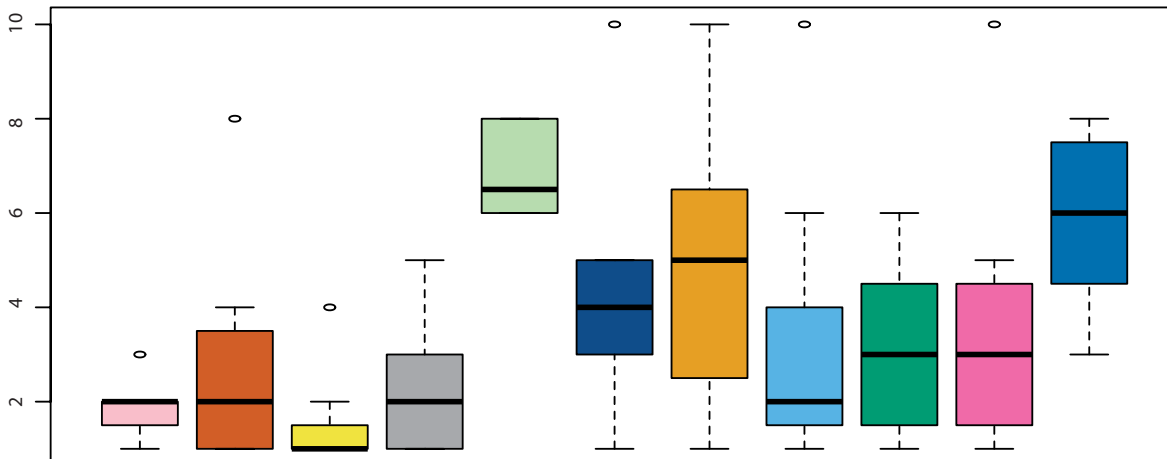
The Lynx Returns



Fairies and Fun



Successful Exotics



lichens, and a participant wondered about viewing management in much longer timescales, in terms of non-native species becoming naturalised.

Managing holistically for the catchment

One of the things that was seen to be missing from all the scenarios was that the management should not just be focused on the specific FCS site of Glen Creran, but it should be more integrated with the catchment and neighbouring landowners. This was perceived to be particularly important with regards to herbivore management across the landscape. It was felt that more emphasis could be placed on using cattle to manage the woodland – to control bracken and create open spaces, woodland edges and a mosaic of habitats: *“If you manage the ground holistically then you should get to a point where grazing animals are a part of that process and the role of cattle in beating up bramble and bracken is really important”*.

Overall, participants felt that natural regeneration of native woodland should be achieved through the management of deer numbers, rather than through the fencing off of areas. Fences were considered *“horrendous”* for lichens, creating dense, shady, impenetrable thickets of brambles and scrub.

One panellist cautioned on micro-managing for one species, saying *“We should be aware not to focus on one thing and actually look at the bigger area... it’s very easy to fall into that trap, trying to create a habitat for one thing that may not, or probably will not, suit the majority of others”*.

Finally, as part of a more holistic and integrated approach to managing the catchment, a participatory budgeting approach to enable greater community-based decision-making in the glen, with regards the allocation of public funds, was proposed.

Preferences for future management

Two future scenarios emerged as favourites from the discussions: Rainforest Beginnings and Fairies and Fun. The focus on ecological outcomes, continued management of invasive species and direct monitoring of lichens and butterflies (all part of Rainforest Beginnings) was welcomed. Panel members thought it could go even further, suggesting reintroducing cattle (as habitat manipulators) to keep glades in the woodlands open. It is interesting to note that Rainforest Beginnings was based on the FCS’s current management plan for the site.

Other participants preferred Fairies and Fun (which focuses on community engagement) because of its inclusivity and potential for volunteer development and training. Again they thought it could go further, adding value to goods such as wood (firewood, furniture) and

venison through branding, and working more with local schools. It was noted that selective, sensitive logging and supplying wood to the local market may need government support to make it sustainable. Concerns were expressed about increased traffic and the impact of more people on the ecological integrity of the site, and participants suggested that some of this could be mitigated by closing the FCS car park, and creating a walking route from the Glasdrum Wood carpark. Greater volunteer and local school engagement could be encouraged with a dedicated full-time ranger. The uniqueness and importance of the site with regards to biodiversity made it an ideal place for training and education. Another panellist felt that some of the historic features of the site, such as Elleric Inn, were not capitalised on enough and could be a valuable tourist attraction to the area.

The least favourite future scenarios were Successful Exotics and The Lynx Returns. It is interesting that The Lynx Returns scenario was viewed negatively overall, despite scoring relatively high in the scoring exercise. This could have been due to an over-emphasis on the reintroduction of the lynx in the title (prioritising the lynx over broader ecological changes), or it may be that it raised broader questions about reintroductions in general. The panel thought reintroducing the lynx was unrealistic, as discussed earlier, although they appreciated the expansion of native woodland. Finally, the Successful Exotics scenario *“lay waste to all the hard work that had been done to date”* and had *“an air of neglect”*. It was considered a disaster for lichen biodiversity and conservation.

Next steps

Over the next year we plan to conduct a further four local expert panel workshops in the other study areas (including Glasdrum Wood National Nature Reserve). After that, we will conduct a cross-site analysis of the data to gain an in-depth overview on how different types of management interventions impact woodland goods, services and benefits from a range of perspectives.

Glen Creran Woods SSSI

Site description

The Forestry Commission Scotland (FCS) - owned Glen Creran woods are situated in the north-eastern part of Glen Creran. The area consists of two parts that are designated as SSSI (Site of Special Scientific Interest) and a small non-designated area in between. The whole area covers 366 ha and extends from the River Creran flood plain up the slopes of Beinn Churalain to an altitude of approximately 450 metres. Glen Creran woods are sandwiched between the multi-use FCS site towards the north-east and another part of the SSSI, the Glasdrum Wood National Nature Reserve (managed by SNH), along its south-western flank. The area is also part of a designated Special Area of Conservation (SAC) due to the mixed woodlands on base-rich soils, and the occurrence of otters in the loch. The nature reserve extends up the north-western slope of a mountain glen. Where the forest opens up, this affords views over Loch Creran and towards the opposite side of the glen. Above the woodlands, more open vegetation extends to the top of the ridge. Historically the area is famous for the Appin Murder of 1752, where Colin Campbell (known as the Red Fox), the government appointed factor of Glenure was assassinated and James Stewart was hanged despite having a solid alibi.



The Early 1980s

The site consists of two areas, one being an exotic conifer plantation which is predominantly managed for production of timber. Large vehicles and machinery can often be seen and heard working, as well as the occasional helicopter which are used for aerial fertilising. The other area is an even age stand of continuous canopy oak woodland and open birch scrub. Hazel, holly, ash and alder are present, the two latter species found along the small water courses that dissect the site. The woodland is very rich in lichens and bryophytes (mosses and liverworts), with 300 species of lichen and 200 bryophytes.

The site also provides habitat for butterflies such as the pearl-bordered fritillary, which are found within the few open areas but particularly on the upper edge of the woodland. As most trees in the site are old and there is not much forest management taking place, there is little ground flora. Eagles have been extinct in the area for a long time. Exotic plant species such as rhododendron and buddleja are abundant throughout the woodland, particularly on lower elevations. Nothing is done to remove the rhododendron, and it is widely considered a popular garden and landscaping plant. Most of the houses in the glen are occupied, with more than 40 people living in the area, but the school closed in the 1970s due to the low number of children in the area. While there used to be excellent salmon fishing in the area, a burst of the upper loch in the 1960s means that a fish ladder was washed away and the salmon are no longer able to migrate all the way up and no longer spawn in the area. There are no formal footpaths in the area.



The Present (2018)

The woodland is mostly comprised of native broadleaf woodland of variable structure, from continuous canopy oak woodland to birch scrub. Ash, alder, hazel, wych elm and holly are also present with the ash and alder being associated with water courses, base-rich flushes and limestone. A small area of exotic conifer plantation still remains in the designated area, with another, larger block of conifers (Sitka and Norway spruce) in the upper part of the non-designated part. This latter part still stands out as a clear block of plantation forestry. In spring, bluebells and ransoms transform the woodland into carpets of blue and white. Until recently the woodland and lichen conservation features of the SSSI site were considered unfavourable due to dense tree regeneration reducing the extent and frequency of open glades, which adversely affects populations of chequered skipper and pearl-bordered fritillary (and other butterfly species) for which the reserve is renowned, and the lichen assemblages (around 300 species) which are of international significance. Shading from rhododendron thickets, lack of mature trees and poor connectivity with Glasdrum Wood National Nature Reserve has made it difficult for the rarer lichen species to re-establish in the woodland. Near the car park an area of former conifer plantation has been cleared and fenced off to allow for regeneration of native broadleaves with a few individual, large oak trees left standing. Currently, this area is therefore very open with a clearly visible deer fence around it. Most other fences have been removed as the regenerating trees are tall enough to withstand browsing by deer.

The site is managed in a targeted manner to improve the overall condition of the woodland and species of conservation interest, and to control invasive non-native plants. Routine management activities include scrub and rhododendron control (through burning and pesticide application), bracken whipping and deer culling. This means that at times there are signs in the area warning visitors not to pick mushrooms due to the use of pesticides. However, garden escapees such as buddleja can be seen at various places in the woodland. Selective removal of oak occurs within the reserve to aid diversification of stands and promote veteran oaks. Both the chequered skipper and pearl-bordered fritillary are monitored annually by conservation volunteers as part of the Butterfly Conservation surveys. In addition, the site is home to pine martens and red squirrels. Golden

eagles can also be seen in the glen, while white-tailed eagles occasionally fly in from the loch.

The short circular marked 'Pine Marten' trail leads visitors through the woodland across lively burns, by waterfalls and cascades. A viewpoint allows visitors to take in views across Loch Creran to Beinn Sgulaire, an impressive Munro, and Glenure, once home of the government factor Colin Campbell. The site is part of the 'Last Clansman' trail which covers all the sites linked to the Appin murder of 1752. An interpretation panel tells visitors about the murder of Colin Campbell, but the route of the 'Last Clansman' trail is not in itself clearly signposted. Another unmarked path leads to the 'fairy bridge', which features on various walking/visitor websites as the main highlight for Glen Creran. A right-of-way path follows the bottom of the glen northeastward to Ballachulish. At places along the circular walk, benches have been set up and trees are removed to maintain the views towards the other side of the glen.



Rainforest Beginnings (2035)

The previously open area close to the car park at Elleric has gradually closed in with native broadleaf species such as oak, alder, hazel and holly so that the two parts of the SSSI now form a continuous area of native broadleaf forest. Through selective felling, the age structure of the woodland has been further diversified to create a varied woodland. However, ash dieback has meant that all ash trees have died off, but new seedlings and saplings are gradually emerging, some of which seem to be resistant to the disease. Although the forest has expanded somewhat upwards as deer numbers have been successfully reduced, the site still includes about 40% open land, and viewpoints are kept open to enhance visitor experience. Deadwood is generally left in the forest in order to benefit deadwood specialist species. The more open, native woodland has further improved conditions for bryophytes and butterflies. Likewise, sightings of raptor species such as white-tailed eagle and golden eagle have increased in the area. Butterfly Conservation still carries out monitoring of butterfly numbers. Vegetation monitoring is now mostly done using remote sensing technology.

The last remaining area of exotic conifer plantation within the SSSI has been harvested and is now naturally regenerating. Higher up towards the ridge, an area of conifers in the non-designated part between the two SSSIs has been replanted as productive forest, but the edges have been softened to follow the contours of the land rather than stand out as a square plantation lot. Deer control is taking place every year.

At the same time, the deer numbers and their impacts are being monitored so that the stalking effort can be adjusted if necessary. The regenerating woodland areas that had previously been fenced off to protect tree seedlings from deer browsing are now mature enough (above deer browse height), and most fences have been removed. Rhododendron removal is part of the continuous management effort at the site. There are still some areas where it has not been possible to remove the rhododendron, and efforts are mainly concentrating on keeping previously treated areas free to help maintain high lichen and bryophyte diversity. To ensure that there is suitable habitat for chequered skipper and pearl-bordered fritillary butterflies, bracken whipping takes place annually in some parts of the wood. However, as climate change has meant fewer late frosts, the density of bracken has increased and it is proving very costly and difficult to keep in check. Targeted thinning and experimental

transplantation of lichens also takes place to encourage lichen repopulation. Priority species and their habitats are regularly monitored. Red squirrels, pine marten, and eagle populations continue to thrive, while populations of many other insect and bird species have gone down.

The existing paths, benches, signposts and information boards are being maintained, but no new infrastructure has been created, and there are no guided walks or other visitor events. The area is mainly used by local people as well as butterfly enthusiasts and occasional visitors.



The Lynx Returns (2035)

Management efforts have concentrated on woodland expansion and the creation of a continuous, native woodland with a diverse species mix and age structure as a typical example of Atlantic rainforest. The woodland predominantly comprises a mix of native broadleaf trees that are commonly found and thrive in the west coast's oceanic climate such as oak, while trees such as alder (and to a lesser degree ash, which has been hit hard by ash dieback) are predominantly found along the riparian edges that dissect the site from the slopes of Beinn Churalain and along the lower margins. The middle slopes of the site consist of a mosaic woodland, with older, well-established oak trees and younger oaks where conifers were cleared and the regrowth has been selectively thinned to give individual trees more space and create a more varied age structure. The last sections of exotic conifer plantations within the SSSI as well as in the area between the SSSI parts have been felled and left to natural regeneration with native broadleaf species. Non-native regeneration is regularly removed. Mixed broadleaf trees dominated by birch are also beginning to colonise the upper slopes of the site after cattle grazing and scarification were used to break down rank vegetation and prepare the soil and the areas were fenced off to prevent browsing by deer. Generally, deer numbers are kept down by continued stalking as well as by the reintroduced lynx in the area. The lynx mainly predate on young and ill individuals, thereby altering the structure of the deer population as well as overall abundance and foraging behaviour.

The previous decade has seen the site being subject to various management interventions. This has seen the near eradication of species which were once considered invasive, such as Japanese knotweed and rhododendron. Rhododendron has been replaced by a mix of woodland flowers, which had to be sown and re-sown for several years after repeated ground preparation until they established. Deadwood, including dead ash, is generally left to benefit specialist deadwood species.

Populations of red squirrels, pine martens and, in the wider area, eagles (golden and white-tailed eagles) have continued to grow. A pair of white-tailed eagles has recently begun nesting adjacent to the site.

The existing, limited network of paths is maintained to ensure the safety of visitors by removing wind-thrown trees which obstruct paths or pose safety risks. However, no particular

efforts are made to attract more visitors to the site and viewpoints which were previously kept open to afford views across the glen have increasingly closed in. There is some engagement with researchers and students from universities (to assist with monitoring), as well as with volunteers from organisations such as Butterfly Conservation. However, due to the technological advances made, most habitat monitoring is now carried out using remote sensing technology and drones.



In order to promote more use by local residents as well as summer visitors, a lot of effort has been put into extending the network of footpaths including one which connects Glen Creran woods SSSI with Glasdrum woods, and installing more benches and picnic spots. A 'fairy trail' leading to the fairy bridge has been created. This includes clearer sign posting, and local artists have created wooden sculptures of fairy tale creatures which are situated in half hidden places along the trail. An interactive 'fairy hunt' has been set up using virtual reality and mobile technology to attract and engage younger and older visitors. From time to time, story-telling events also take place in the story circle, a round clearing set up like an amphitheatre, about half way to the fairy bridge. Another signposted path runs along the ridge of the glen, connecting early Christian sites as well as Victorian monuments. The different paths are connected with each other, providing options for circular routes of varying lengths as well as longer, linear walks through the wider area and virtual signposts allow visitors to access information about the routes and the plants and animals and historic relics in the area.

A local wood group has also been set up to implement the periodic felling of small areas and carry out selective thinning to encourage butterfly and lichen assemblages and diversify the age structure of the wood. In turn, the group derives wood for fire wood and handicrafts from the site. Felled trees are removed using horses, and this is a popular tourist event in the summer. To encourage local and sustainable use and management of wood, woodworking skills training events and festivals are carried out annually where experts demonstrate and teach different woodworking and management techniques including coppicing, live fencing, wood turning and greenwood carving. A simple nature camp site has been set up not far from the main car park. It contains a compost toilet, solar shower and cleared area where people can pitch their tents. Together with a local mountain biking club and a tourism operator, mountain bike paths have been set up in the adjacent non-SSSI FCS site. There are different routes, graded according to difficulty. The tourism operator is based at Ballachulish from where the mountain bike trails start and where visitors can rent bikes, and together with the mountain bike club, an annual mountain bike competition is held in July. This has created some conflict with other users especially as the mountain bikers sometimes veer into the SSSI area, and their activities contribute to the erosion of the paths.

A lot of emphasis in the management is on keeping the area safe and visually attractive. Rhododendron and bracken are removed from some areas, but left alone in others, and visually attractive species such as buddleja are left in place even though they are not native. Keeping bracken down has become more difficult due to the warmer climate which has created ideal conditions for bracken. As people are nervous about tick-transmitted diseases such as Lyme disease, high priority is given to keeping the bracken down along the main paths and this requires a lot of resources. Selective felling takes place to maintain open viewpoints and a varied forest structure and to ensure that there are no risks to visitors from fallen trees. Most of the ash trees have succumbed to ash dieback leaving gaps and deadwood in the forests. Some of the dead trees have been used for the fairy sculptures. Deer fences have been taken down as they were seen as barriers for walkers. Deer management takes place by leasing out the shooting to a local stalking syndicate. Monitoring takes place through volunteers from organisations such as Butterfly Conservation, as well as local school projects. Pine marten walks and white-tailed eagle watching are organised during the summer months. A bird watching tower has been set up allowing visitors to watch the eagles as they fish in the loch while webcams near the eagles' nests give visitors the opportunity to follow the progress of the eagle chicks.





Only the most necessary management operations are carried out. The woodland is comprised of areas of dense thickets of native broadleaf trees with some remaining open glades, though these have been closing in through tree and shrub regeneration, including non-native conifers seeding in from the small remaining area of exotic conifer plantation and elsewhere in the glen. As there is no selective thinning being carried out, the forest is very dense in places, though the more palatable seedlings and saplings suffer from heavy grazing pressure due to increasing numbers of deer. This high grazing pressure has led to more open areas. The impact of deer grazing on new regeneration can be clearly observed in the unfenced area near the car park, in contrast to the fenced areas nearby. Generally across the site very few young trees (particularly the palatable ones like ash and oak) are reaching canopy level, except for the non-native conifers that are much less palatable to deer. There is a long-term lease for deer stalking with one of the local estates, but as their stalking activities focus on stags, the number of hinds has been slowly growing over the years. The high grazing pressure also prevents the woodland extending further up the slopes of the glen as it might otherwise have done, especially as there is no money to fence off areas or use other techniques to promote tree growth.

Footpaths are no longer maintained, and the previously existing trails have thus become informal and are not advertised anywhere anymore. Wind-thrown trees are left in place, unless they pose direct risks (e.g. next to the road). Benches, information materials and also the car park at Elleric have been removed as they could not be maintained. All in all this means that visitor numbers have gone down a lot, especially as tick abundance has increased due to climate change, so that potential walkers are deterred from walking through areas with much bracken and other overgrown vegetation.

Most efforts to remove invasive plants have stopped, limiting any efforts to those required by the law. As a consequence, species such as rhododendron have spread again and form a very dense understorey vegetation in places, to the near exclusion of other species. However, some management interventions are unavoidable, such as felling old trees close to the road before they become a hazard or carrying out disease control through selective removal of infected individual trees.

Monitoring only takes place to comply with legal requirements and in so far as external groups such as Butterfly Conservation or university students carry out projects in the site, but this, too, has become less frequent as the conservation value of the site has declined and there are no staff resources available to support volunteer groups or researchers. Several lichen species have gone back to unfavourable status as the forest and undergrowth have grown denser, and, although the wayleaves are still maintained by the electricity company, populations of chequered skipper and pearl-bordered fritillary have likewise declined.



Appendix Two - Indicators:

Changes in people's benefits from Glen Creran

	Indicator	Explanation
1	<p>Employment and Income</p> <p>Overall, how well do you think each scenario delivers with regards to employment, i.e. the number of jobs directly or indirectly linked to the site?</p>	<p>Consider for each scenario the impact on employment for the area. Think about the impact each scenario has on the diversity of jobs available in the local area and whether these are likely to be unskilled, skilled or professional jobs.</p>
2	<p>Target Species A – Spring Flowers</p> <p>Overall, how well do you think the scenario encourages woodland Spring Flowers (bluebell, wood anemone, violets etc.)?</p>	<p>Consider for each scenario to what extent the various management interventions lead to more open, woodlands, with moderate levels of disturbance and species rich ground flora.</p>
3	<p>Target Species B – brambles, bracken and rhododendron</p> <p>Overall, how well do you think the scenario suppresses species such as bramble, bracken and rhododendron?</p>	<p>For this indicator we are interested in the impact of the scenario on species that are considered 'bad for biodiversity' as they potentially exclude others, leading to reduced species diversity. In this case, a high score indicates that these species would be kept at bay in a given scenario.</p>
4	<p>Timber Extraction</p> <p>Overall, how do you think each scenario will affect the actual extraction of different types of wood materials (i.e. construction timber, wood fuel, wood for pulp, craft woods) from the site?</p>	<p>This indicator refers to wood/timber materials for different uses that are extracted from the site under the different scenarios. Please consider in your answers both the availability of such materials and the extent to which it is actually taken off site.</p>
5	<p>Carbon Stored</p> <p>Overall, how do you think each scenario will affect the amount of carbon stored at the site?</p>	<p>Please consider in your answer that all of the components of the site potentially contribute to carbon uptake and storage, e.g. trees, understory shrubs and grasses, mosses, but also the carbon in the soil itself.</p>
6	<p>Mental Restoration</p> <p>Overall, to what extent does each scenario promote people's feelings of being relaxed and restored?</p>	<p>This indicator relates to subjective experiences that contribute to mental wellbeing. In your answer please consider how each scenario would affect users' feelings of calmness and tranquillity, stress relief and escape from daily hassles/problems, and feeling refreshed and re-energised. This includes local residents, visitors and any other people using the site.</p>



Indicator		Explanation
7	<p>Spirituality</p> <p>Overall, how well do you think each scenario delivers on opportunities for spiritual experiences?</p>	<p>This indicator refers to how each scenario fosters a sense of encountering something sacred or bigger than oneself, and promotes a sense of wonder.</p>
8	<p>Learning, Knowledge and Skills</p> <p>Overall, how well do you think each scenario delivers on opportunities for training, education and learning?</p>	<p>Please consider the full range of potential knowledge, skills and training opportunities and all age groups – from traditional land management skills to handicrafts, to research and monitoring, to outdoor education and mountaineering skills.</p>
9	<p>Landscape quality and character</p> <p>Overall, how well do you think the scenario delivers on perceived landscape quality and character?</p>	<p>To which extent do you think people will appreciate the landscape, in terms of its visual aesthetics as well as its other features and its overall character?</p> <p>Consider how the different elements and features (natural and human made) make up the landscape in the scenario.</p>
10	<p>Place Attachment</p> <p>Overall, how well do you think each scenario supports local people/visitors in forming and/or maintaining a strong attachment to this place?</p>	<p>How might each scenario affect people's emotional connection to the site? Please consider how the changes described in the scenario would affect the emotional significance of the place for individuals, as well as extent to which users would experience feelings of belonging and being 'at home'.</p>
11	<p>Natural Flood Management</p> <p>Overall, how well do you think each scenario provides protection from flooding, e.g. through natural flood management?</p>	<p>Do any scenarios increase or decrease the risk of flooding either in the upper or lower catchment? Consider how the vegetation and soil structure in each scenario may affect the volume and speed of surface water run off or soil permeability.</p>



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