

Knoydart Foundation, Inverguiserain and Black Hills neighbours

Wild Trees Survey findings



Trees for L_life





Temperate rainforest along the Scotas Burn

Acknowledgements

The Knoydart Foundation, Inverguiserrain and Black Hills neighbours Wild Trees Survey was a partnership project between the Knoydart Foundation, Knoydart Forest Trust and Trees for Life. The Partnership are grateful to the National Lottery Heritage Fund, Highland and Islands Environment Foundation, and Startline Motor Finance for generously funding the project, and to landowners across the survey area who have engaged with the survey and its findings. The project would not have been possible without the work of staff across the partner organisations and the support of the wider Knoydart community.



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Executive summary

A Wild Trees Survey was carried out across part of Knoydart, including the Knoydart Foundation, Inverguisera Estates. This covered around 8,500 hectares using 1396 plots and 248 transects. 240 hectares of Ancient Woodland were mapped and 21 key refuges for wild trees and refugial species identified. Total diversity was found to be high but concentrated in small, relatively inaccessible hotspots that were widely distributed across the landscape. While extensive efforts have been undertaken to regenerate and expand native woodland using deer fencing, some areas of Ancient Woodland remain unprotected and were considered critically threatened. The main threat and barrier to recovery was found to be levels of herbivore impact, which were high or greater across 49% of the survey area. Invasive non-native species were considered a secondary threat and concentrated around Inverie. However, the potential for recovery was high, with significant scope for natural regeneration and expansion of woodland: an estimated 1.5 million native trees and shrubs could establish naturally based on existing seedling densities, expanding tree cover by around 1700 hectares. Vegetation recovery could also support more palatable, insect-pollinated, and berry-producing plants. 11 recommendations are made to help realise this potential, and secure healthy and resilient wild tree populations and woodland habitats across the landscape.

1. Introduction

1.1. Wild trees

Wild trees are Scotland's natural tree populations. They are part of an unbroken chain of natural regeneration that goes right back to the end of the last ice age. Despite thousands of years of deforestation, wild trees remain surprisingly widespread in the Scottish Highlands today. They survive in small refuges like crags and steep-sided ravines, as well as larger Ancient Woodlands. Many of these have Gaelic placenames and are culturally important, like Doire nan Taghan which means 'wood of the pine marten'. Wild trees, and the places they grow, support high biodiversity, including many 'refugial species' that have been lost from the wider landscape. Most wild tree populations are also genetically diverse, making them more adaptable to threats from disease and climate change [1,2,3,4].

Wild trees are threatened by centuries of heavy grazing pressure from livestock and deer across most of the Scottish Highlands. This prevents young trees from growing up to replace old ones that die, causing Ancient Woodlands to slowly fall apart. At the end of this process, the only places wild trees survive are where livestock and deer cannot reach, like crags and steep-sided ravines. However, wild trees can reforest whole landscapes when conditions are right. This has taken place recently in western Norway and the Burren region of Ireland, where reduced grazing pressure allowed relict wild trees to naturally regenerate and recolonise deforested areas at scale. These naturally expanded woodlands are often more structurally complex and biodiverse than plantations. The same is now happening in parts of Scotland due to improved deer management, with 164 hectares of natural woodland expansion happening each year in Strathspey [5].

1.2. Wild Trees Survey

Trees for Life have developed a framework to help prioritise wild trees when making land management decisions. The Wild Trees Survey is a key part of this. It has been designed to identify refuges across a landscape or landholding, and gain an understanding of:

1. Diversity present, and where it is most concentrated.
2. Threats to diversity, and which areas and actions should be prioritised.
3. Potential for recovery.

The Knoydart Foundation, Knoydart Forest Trust and Trees for Life worked in partnership to carry out a Wild Trees Survey across part of Knoydart. The survey methodology was adapted to establish an ecological baseline across the whole landscape and for compatibility with future monitoring. Training and survey work was funded by the Highland and Islands Environment Foundation, Startline Motor Finance, and the Heritage Fund, thanks to National Lottery players. Results from the survey are feeding into the Knoydart FIRNS (Facility for Investment Ready Nature Scotland) project.



Oak canopy from a steep-sided ravine



Surveyors documenting bird cherry and tall herbs along Allt Ferna

1.3. The survey area

Knoydart is a mountainous peninsula in the western Highlands. It is bounded by the Sound of Sleat and its branching sea lochs, Loch Hourn to the north and Loch Nevis to the south. The main settlement, Inverie, is located along the south coast and accessed mainly by ferry. Other settlements, including Sandaig, Airor and Inverguseran, are concentrated along the west coast and connected to Inverie by internal roads and tracks.

Historically part of the Viking Kingdom of the Isles and later Clan MacDonnell of Glengarry's lands, the people of Knoydart were severely impacted by the Highland Clearances, including the mass eviction of around 330 people in 1853 to make way for large-scale sheep farming. Cattle grazing was the main land use prior to the Clearances. Knoydart was sold by the MacDonnells in 1856 and was later acquired by the notorious Lord Brocket, who managed the Estate for sport shooting. His authority was challenged during a land raid in 1948 by the Seven Men of Knoydart. Ownership of Knoydart diversified in the late 1900s as parts of the Estate were sold off, with the largest area acquired by the community-run Knoydart Foundation in 1999.

The survey area spans around 8,500 hectares on the western part of the peninsula, including the Knoydart Foundation and Inverguiserain Estates, along with several smaller landholdings along the west coast and around Inverie. Its boundary largely follows the ridge that runs from Sgùrr Coire Chòinnichean above Inverie northeast to Stob a' Chearcaill and Ladhar Bheinn, the tallest mountain on Knoydart with a summit 1,020 metres above sea level. The interior landscape comprises Gleann na Guiserein and two groups of hills, the Black Hills to the southwest and Beinn na Caillich, Meall Coire an t-Searraich and Na Cruachan to the north. The coast is rugged with dispersed settlement, including Inverie and Scottas along the southern stretch, Reidh an Daraich, Sandaig, Doune, Airor and Inverguseran along the western stretch, and Croulin along the northern stretch. The climate is cool-temperate and hyperoceanic. Summers are cool, winters are mild, and both annual rainfall and the number of wet days per year are very high [6]. Bedrock is mainly psammite, semipelite and pelite [7], often capped with peat where terrain is flat or gently sloping.

Early records of woodland were made by 16th century cartographer Timothy Pont, who described 'plentie of wood on both syds' of Loch Hourn [8]. Thomas Pennant, a Welsh travel writer, later wrote in 1772 that 'The scenery that surrounds the whole of this lake [Loch Hourn] has an Alpine wildness and magnificence; the hills of an enormous height, and for the most part clothed with extensive forests of oak and birch, often to the very summits... On the south side, or the country of Knoydart, are vast numbers of pines [likely concentrated on Barrisdale Estate], scattered among the other trees, and multitudes of young ones springing up [9]. Historical maps from the mid-1700s [10] to mid-1800s [11] depict the survey area as a mostly open landscape with woodland surviving in three main areas: along the south coast on the slopes above Inverie and at Scottas, along the north coast from east of Slisneach to Croulin, and in Gleann na Guiserein on the slopes either side of Allt Fearnna. The Inverie woods were only shown on the earliest map [10], suggesting they were lost sometime between 1750 and 1850.

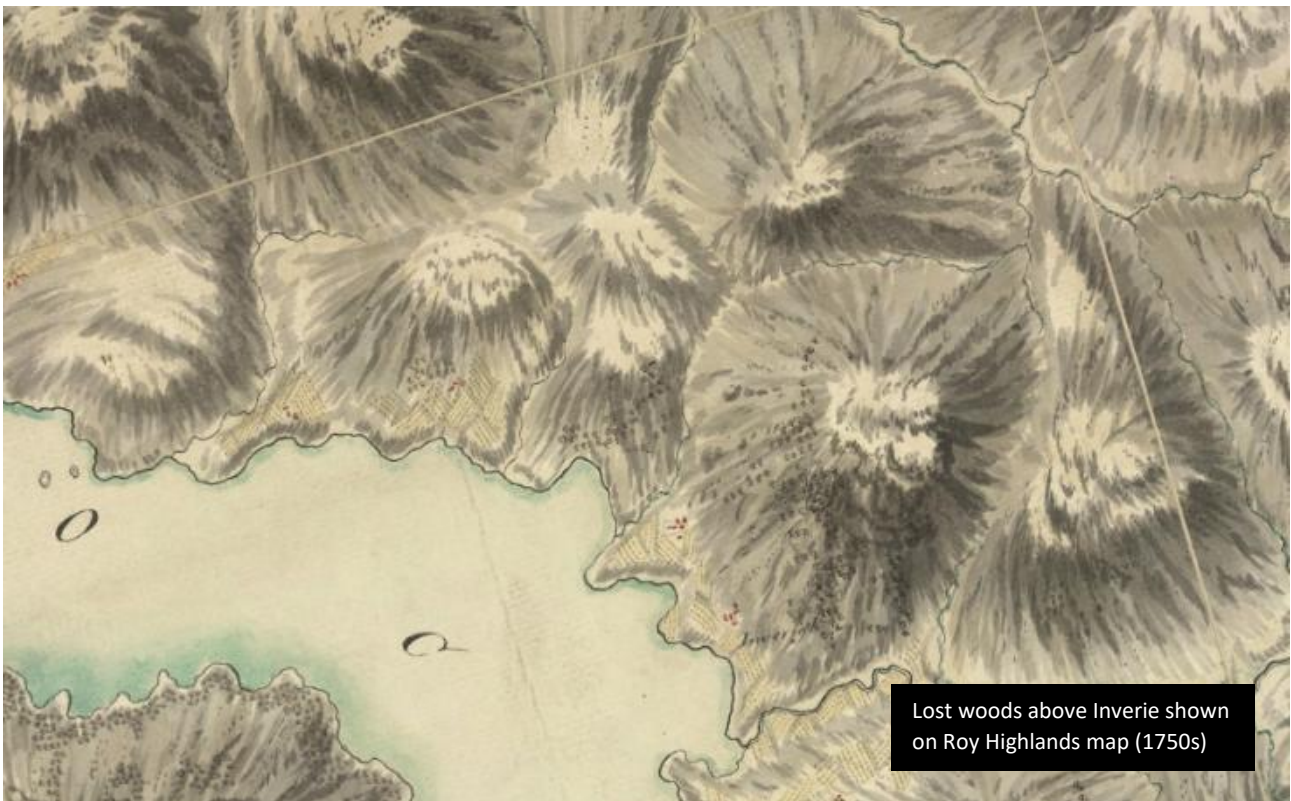
The 1st Ordnance Survey (OS) map, surveyed in 1873, shows the first accurate depiction of tree cover across the survey area, including areas of open woodland and scattered trees [12]. It suggests that the densest surviving natural woods were at Scottas on the south coast and between Allt na Crìche and Allt Coire na h-Aisre on the north coast. Other woods shown on the earlier maps are depicted as open woodland or scattered trees on the 1st OS, and additional areas with scattered trees are shown along the coasts of Rubha Raonuill, Am Port, Airor, Samadalan, Niag-àrd and Inverguseran, as well as parts of the Abhainn Inbhir Ghuiserein and several ravines including the Sandaig and Airor Burns. Plantations are shown around Inverie House, and field evidence suggests these likely had a degree of continuity with the earlier Inverie woods. Some areas depicted as open on the 1st OS map also had tree placenames, indicating sites of lost woodland. These include Doire Fhada ('long thicket'), Reidh an Daraich ('plain of the oak'), Lochan a' Choire Sheilich

(‘lochan of the willow corrie’), Bealach an Fhiodha (‘pass of the timber’) and Sròn Dubh-dhoire (‘snout of the black wood’) in the Black Hills, and Allt na Doire Gaothaire (‘burn of the windy wood’) and Coire na Craoibhe (‘corrie of the tree’) in Gleann na Guiserein (‘glen of the pines’).

Woodland and scattered trees are still found today in many of the areas they were depicted on historical maps, with around 240 hectares of Ancient Woodland provisionally mapped. Ancient Woodlands are areas understood from historical sources to have been continuously wooded since the mid-1700s. Ancient Woodlands across the survey area also form temperate rainforest, a globally rare biome important for bryophytes and lichens. However, some areas appear to have declined over the past 150 years, now supporting only relictual tree cover. These include the slopes around Allt Fearn in Gleann na Guiserein, and along some ravines like the Allt nan Imireachan and Allt nan Caiseachan, where trees have been lost from more accessible stretches.

Additional areas of Ancient Woodland are found on Knoydart beyond the survey area. The greatest concentration is at Barrisdale, which supports one of the most extensive Ancient Woodland complexes in the Western Highlands [13]. Parts of the Barrisdale woods are designated as Glen Barisdale Site of Special Scientific Interest (SSSI) for native pinewood, upland birch woodland, and their lichen assemblage. Knoydart also supports Caledonian Pinewood, a rare habitat characterised by wild populations of Scots pine. 3 of the 84 Caledonian Pinewood Inventory (CPI) sites are found on Knoydart. These are Glen Barisdale, Loch Hourn, and Lochourn River CPI sites [14]. Relict Caledonian Pinewoods have also been identified in Gleann Còsaidh and at Slios Garbh [13,15].

Efforts to regenerate and expand native woodlands across the survey area were commenced in 1994 with erection of deer fences at Garsley and Satial [16]. Work accelerated under the leadership of the community-run Knoydart Forest Trust, established in 1999, Inverguiserain Estate and Airor Common Grazings. Today around 30 deer fenced enclosures cover 46% of the survey area, including the very large Black Hills fence created by joining together several of the smaller enclosures in 2023. The other main land uses are deer stalking and sheep farming.



Plan
of the Estate of
KNOYDART

*This is the lithographed plan of the Estate of Knoydart,
referred to in the deed of Agreement executed by us of the
date attached to our subscription.*

*See instructions on
page 10.*

*X H all add plan & date
X E E do*



Woodland shown on 'Plan of the estate of Knoydart' historical map (1850)



Tree symbols and woodland depicted on the 1st OS map overlaid on an aerial image of west Knoydart

2. Methodology

2.1. Conceptual framework

Healthy and resilient wild tree populations and woodland habitats can better support wildlife, recover after disturbance, and adapt to change. Important characteristics of health and resilience are [17]:

1. Diversity, which includes the genetic diversity of populations, the range of different native tree species present, and the range and quality of habitats that they help provide.
2. Continuity, which includes the ability of wild tree populations to maintain themselves through regeneration and recruitment, and replenishment of important habitat features like deadwood.
3. Mobility, which includes the ability of wild tree populations to expand into the wider landscape to help track changes in climate.
4. Connectivity, which includes the scale of woodland habitats and how well joined up they are.

Pressures that can influence health and resilience include herbivore impacts, non-native species, and fire.

These health and resilience characteristics informed the design of the Wild Trees Survey and guided management recommendations provided in Section 4.

2.2. Identifying refuges

Potential refuges were identified across the survey area from historical maps and aerial imagery. They included:

- Areas where unenclosed tree symbols were depicted on the 1st OS map, the first map of the Highlands accurate at finescale.
- Areas where semi-natural woodland or scattered trees could be identified from aerial imagery.

Potential refuges were assigned corresponding local placenames where possible.

2.3. Survey plots and transects

Most field data was recorded within plots and along transects. Plots were placed in a grid across potential refuges, typically at a density of 1 plot every 2 hectares. Additional plots were placed at a density of 1 plot every 8 hectares outside potential refuges to establish a wider baseline. The centroid of each plot corresponds with the centroid of a six-figure British National Grid square. Plots were circular with a radius of 10 m. Each had a nested 5.6 m radius subplot.

Transects were placed along watercourses within potential refuges. They started 50 m upstream from the confluence and were typically repeated every 200 m thereafter. Transects were 10 m in length and ran upstream along the watercourse. They extended 2.5 m perpendicular from the edge of each bank, or 2.5 m perpendicular from the edge of associated steep slopes where these were present.

Data collected in both plots and transects included general attributes like surveyor, date, and time; presence of regeneration by tree species; abundance of maturing, mature, senescent¹ and dead trees by tree species; browsing rates on regeneration and lower shoots by tree species; and a list of refugial species² present. Additional data collected in plots only included the abundance and height of regeneration²; vegetation composition and structure²; and browsing levels on 7 vegetation browsing indicator species. Further details are provided in Appendix 1.

¹ Senescent trees are trees that have grown past maturity, often characterised by attached deadwood or signs of decay.

² Data collected within subplots rather than from the whole plot area.

Additional field data was recorded as notes where features of interest were found outwith plots and transects.

2.4. Data collection

Fieldwork was carried out over 9 weeks in spring and summer 2025, starting on 5th May and finishing on 17th August. Additional notes were taken during a visit on 13th September. The survey team was made up of members of the local community, including Knoydart Foundation and Knoydart Forest Trust staff, alongside Trees for Life staff and Gus Routledge at Adoxa Ecology. Local surveyors were Alice Lemkes, Bella Mir, Calum Wilson, Costa Schaller, Finlay Greig, Jim Brown, Josh Gilbert, Lewis Robb, Lorna Schofield and Daniel Wood. Trees for Life staff were James Rainey and Fergus Higgins. A total of 1396 plots and 248 transects were surveyed and 1224 notes taken.

2.5. Data analysis and interpretation

Scaling factors were assigned to each plot and transect based on the area in hectares or length in hundred metres that they represented respectively. Data was then processed to calculate relevant diversity, continuity, herbivore impacts, and non-native species metrics. This included scaling of tree abundance data from plots and transects to calculate estimated abundance totals and average densities. Tree recruitment values were determined by regressing abundances at different growth stages and interpreting the overall trend. Raw tree and vegetation browsing data were categorised by palatability class and processed following an adaptation of Armstrong *et al.* (2023) [18] to calculate impact scores for 5 indicators, see Appendix 1 for details. An overall herbivore impact score was then assigned to each plot based on interpretation of these indicator scores. Recovery priority levels were assigned to refuges according to criteria given in Appendix 2. Maps of processed plot, transect, and note data (as appropriate) were created to show the distribution and variability of tree species composition, diversity, growth structure, established density, and regeneration density; refugial species diversity; herbivore impacts, and browsing rates for different tree and vegetation palatability classes; and presence of non-native species. Maps are presented in Appendix 3. Processed plot, transect, and note data were also counted, summed, or averaged (as appropriate) to generate refuge and site-level data, which are presented in summary tables in Appendix 4.



3. Wild trees in the survey area

3.1. Key refuges

21 key refuges for wild trees and refugial species were identified and surveyed across the survey area, see Table 1 and Map 1 for details. These were widely distributed and ranged from sea level to over 1000 metres in elevation. They supported a range of habitats, including Ancient Semi-Natural Woodland (ASNW), temperate rainforest, and tall herb vegetation. The distribution of established woodland is shown in Map 2.

Table 1: Overview of wild tree refuges across the survey area

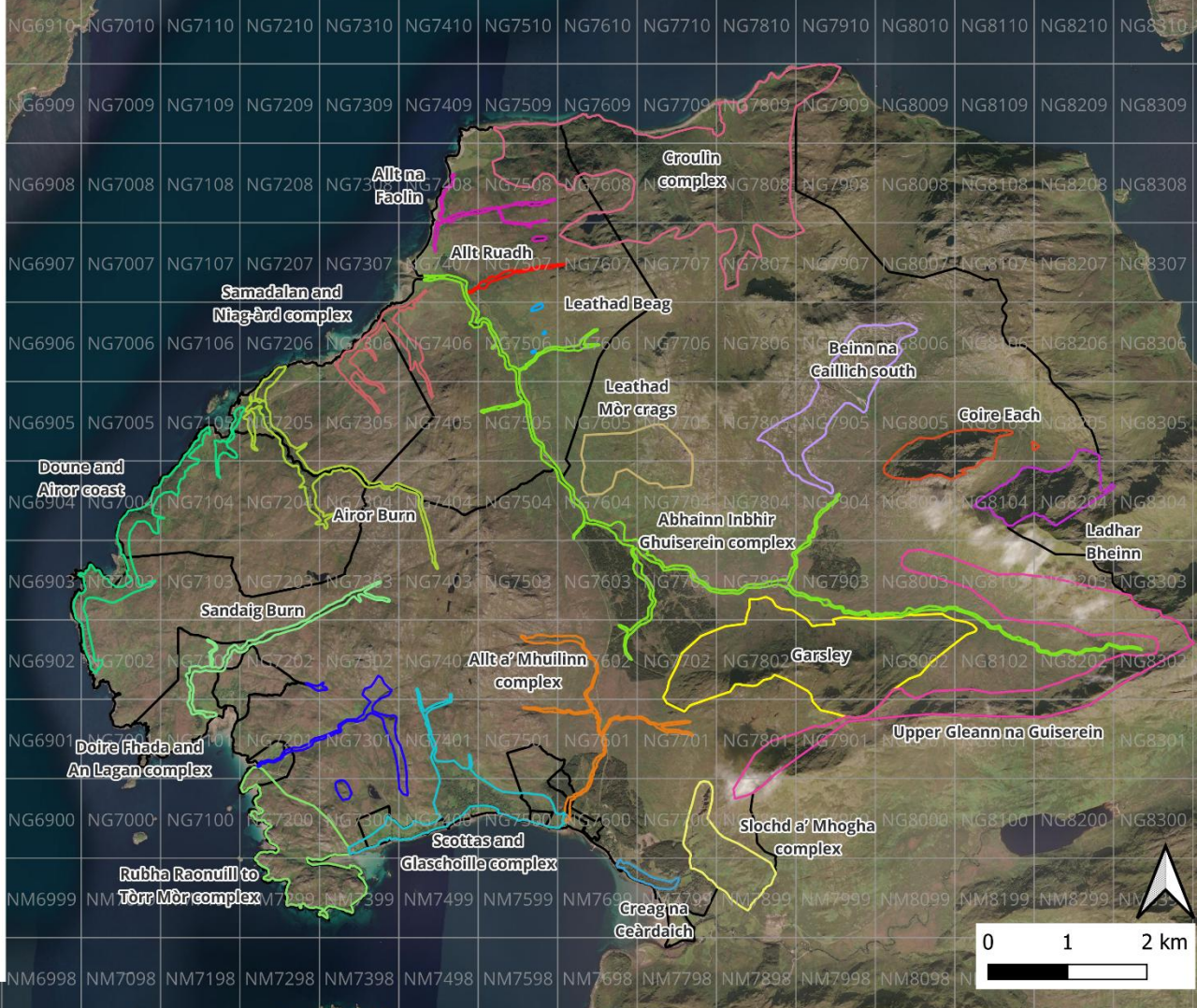
Refuge	Description	Survey effort
Slochd a' Mhogha complex 'pass of the bow'	Slochd a' Mhogha is a jagged gorge that rises above Inverie. A small burn, the Allt Doilleirichte, runs through it. The lower third of the Slochd is wooded (ASNW), while the upper section supports a rich assemblage of alpine plants. Scattered wild trees are also found to the east of the Slochd, including on crags at the foot of Coire na Cloiche. The slopes below Coire na Cloiche were deer fenced to create the White Gate enclosure in 2017, and this area has been planted.	18 plots and 5 transects were surveyed and 22 notes taken.
Creag na Ceàrdaich 'crag of the forge'	Creag na Ceàrdaich is a crag just west of Knoydart Community Hall. Part of the area was planted, probably in the early 1800s when Inverie House was constructed. The lichen assemblage suggests this planted wood may have had continuity with earlier semi-natural woodland. Today the wood is dominated by birch, alder, and non-native western red cedar. Creag na Ceàrdaich is within the long-established Inverie deer fence.	4 plots were surveyed and 21 notes taken.
Allt a' Mhuilinn complex 'the mill burn'	The Allt a' Mhuilinn or Mill Burn drains a small catchment centred around Màm Uidhe, the main pass from Inverie to Gleann na Guiserein. It has three tributary streams: the Allt na Faing, Allt nan Imireachan, and Allt nan Caiseachan. Patches of ASNW occur along parts of the lower main river, and within ravine sections of the tributary streams. The lower half of the river is within the Inverie deer fence, the Allt na Faing is within the Fank Burn fence (completed 2015), and the Allt nan Imireachan is within the Black Hills fence (completed 2023). Allt nan Caiseachan is not fenced.	11 plots and 19 transects were surveyed and 56 notes taken.
Scottas and Glaschoille complex	The largest areas of semi-natural woodland around Inverie Bay run from Scottas to Glaschoille. Historically fragmented, young woodland has spread from core ASNW areas within the long-established Scottas fence, and between the road and sea at Glaschoille. Above the Scottas fence, ASNW is distributed patchily along the Scotas Burn. This area, and the woods at Glaschoille, are now within the Black Hills fence. Birch, alder and eared willow are dominant, but oak, ash and hazel are also locally significant.	43 plots and 10 transects were surveyed and 56 notes taken.
Rubha Raonuill to Tòrr Mòr complex 'Ranald point' to 'big mound'	Rubha Raonuill is a small peninsula that extends from Knoydart's south coast, and Tòrr Mòr is a hillock on its west coast. The area of ground between supports small patches of ASNW and scattered trees on crags.	27 plots were surveyed and 54 notes taken.
Doire Fhada and An Lagan complex 'the little hollow'	Doire Fhada is part of the Black Hills northeast of Glaschoille, and An Lagan is a nearby hollow that the road from Inverie to Aior passes through. The Allt an Lagain runs through An Lagan to the sea at Reidh an Daraich. Scattered shrubby trees are found along Allt an Lagain and on steep west-facing crags along Doire Fhada. Doire Fhada and An Lagan are within the Black Hills fence. Parts of the surrounding area have recently been mounded and planted.	4 plots and 7 transects were surveyed and 16 notes taken.

Refuge	Description	Survey effort
Sandaig Burn	The Sandaig Burn rises in the Black Hills and empties to the sea at Sandaig, a small settlement on Knoydart's west coast. The lower half of the burn has gentle slopes for the most part, with a small ravine section directly west of St. Anthony's Chapel the main exception, while the upper half is a steep-sided ravine. Ravines are typically wooded or support patchy tree cover, including small areas of ASNW. The Sandaig Burn is within the Black Hills fence, and two sections pass through older deer fenced enclosures: Torr Bàn, completed 2011, and Sandaig Burn, completed 2004. The older enclosures have been planted.	6 plots and 12 transects were surveyed and 39 notes taken.
Doune and Aior coast	The coast around Doune supports scattered wind-clipped trees on cliffs and crags, and a band of ASNW and associated young woodland occurs towards Aior. The lower section of the Allt Ailein, which empties to the sea at Aior, is also wooded. While birch is generally dominant, hazel and to a lesser extent oak form significant components. The whole area is within the Black Hills fence, and stock fencing separates in-bye from the wooded coastal strip at Aior. A patch of woodland east of the Allt Ailein is also within the Aior deer fence (completed 2013).	20 plots and 6 transects were surveyed and 49 notes taken.
Aior Burn	The Aior Burn is the biggest river that rises in the Black Hills. The main river runs through a wooded gorge, and the tributaries, Allt a' Choire Sheilich and Allt na Teanga Meadhonaich, are also steep-sided but with patchier tree cover. Woodland is largely ASNW. Most of the Aior Burn and Allt na Teanga Meadhonaich are within the Aior deer fence, completed 2013, while the remainder along Allt a' Choire Sheilich is within the Black Hills fence. Satellite woods near the mouth of the Burn are also included.	17 plots and 25 transects were surveyed and 51 notes taken.
Samadalan and Niag-àrd complex	The coastal strip from Samadalan to Niag-àrd and associated burns, including Allt na h-Innse Duirche and Allt Niag-àrd, support patchy ASNW and scattered trees. The upper part of Samadalan is within the Black Hills fence, with the remainder within Aior Common Grazings and cattle grazed in summer. Most of Niag-àrd is within the Niag-àrd deer fence (completed 1996 and extended 2000). A smaller part is sheep grazed.	9 plots and 17 transect were surveyed and 36 notes taken.
Abhainn Inbhir Ghuiserein complex 'river of the mouth of the pines'	Abhainn Inbhir Ghuiserein is the main river that runs through Gleann na Guiserein. It empties at Inverguseran and is fed by two main tributaries, the Abhainn Bheag and Allt Coire Torr an Asgaill, which merge downstream of Folach. A few smaller tributaries are also included in the complex: Allt Doir a' Chaoruinn, Allt Cluain-airighe and Allt an Drollaire. Strips of ASNW are distributed patchily along the watercourses, with alder a major component on shallow riverbanks and birch, rowan and some oak in steeper areas. Some wooded sections of the river are within deer fences, including the Gorge Wood and Guiserein Bridge fences (both completed 2012), and Abhainn Bheag (completed 2007). Additional fenced areas run close to the river on the west side of Inverguseran and at Abhainn Bheag Mòr. ASNW along Allt Doir a' Chaoruinn is embedded within a lodgepole pine plantation. Sheep graze along the main river and Allt an Drollaire outwith fences.	37 plots and 66 transects were surveyed and 57 notes taken.
Allt Ruadh 'red burn'	Allt Ruadh is a steep-sided ravine that runs into Abhainn Inbhir Ghuiserein near Inverguseran. It supports a strip of diverse ASNW. The lower half runs through the Allt Ruadh deer fence, which was completed in 1996. The upper half is within a sheep grazed area.	3 plots and 6 transects were surveyed and 27 notes taken.
Leathad Beag 'wee slope'	Leathad Beag is a west-facing slope in lower Gleann na Guiserein. Scattered trees occur at NG757069 in a craggy hollow, and a few other areas north of Allt an Drollaire. The area is sheep grazed.	No plots or transects fell within this small refuge, but 4 notes were taken.

Refuge	Description	Survey effort
Leathad Mòr crags 'big slope'	Leathad Mòr is another west-facing slope in Gleann na Guiserein above Guiserein Bridge. Scattered trees including oak, ash and elm occur on crags across the area. The lower part is within the Guiserein Bridge deer fence, completed 2012, with the remainder sheep grazed.	12 plots were surveyed and 20 notes taken.
Garsley	Steep north-facing slopes above Garsley in upper Gleann na Guiserein support a significant area of ASNW dominated by birch and rowan. The greater part of this was deer fenced in 1994 to form the Garsley fence, and natural regeneration and planted trees have since filled out and expanded the woodland here. Several streams, including the Garsley Burn and Allt Coir' an Tighe, run through the fence. Outside, relict ASNW is made up of thinly scattered trees on accessible ground, including at Meall an Uillt-fheàrna, with denser patches on crags and along the Allt Feàrna.	119 plots and 17 transects were surveyed and 105 notes taken.
Upper Gleann na Guiserein 'glen of the pines'	Upper Gleann na Guiserein comprises part of the south side of Ladhar Bheinn and high-altitude north-facing slopes and crags extending from Sgùrr Coire Chòinnichean to Aonach Sgoilte. This area includes scattered trees and fragments of ASNW, as well as ledges with tall herb vegetation.	31 plots were surveyed and 55 notes taken
Beinn na Caillich south	The steep, east-facing slopes that stretch from the south side of Beinn na Caillich to Allt a' Chaoruinn support scattered trees on crags and in ravines. There are also some patches of juniper scrub.	18 plots and 4 transects were surveyed and 49 notes taken.
Coire Each 'corrie of the horse'	Steep north facing slopes and crags in Coire Each support patchy woodland and scattered trees. Rowan is dominant but birch is also present locally, including at the waterfall in the upper part of Allt Coire Each.	9 plots and 1 transect were surveyed and 30 notes taken.
Ladhar Bheinn 'hill of the hoof or claw'	Ladhar Bheinn is the highest peak on Knoydart. Its north side is steep and rugged, with pockets of dwarf willow and tall herb vegetation. There are also a few scattered rowan.	11 plots were surveyed and 11 notes taken.
Allt na Faolin	Allt na Faolin is a steep-sided ravine that runs into the sea north of Inverguseran. It supports a strip of diverse ASNW. The lower part runs through the Allt na Faolin deer fence, completed 1996, and most of the remainder runs through the Ambidein deer fence, completed 2013. The uppermost part is unfenced. Also included are scattered trees along the adjacent coast which is grazed by sheep.	7 plots and 9 transects were surveyed and 20 notes taken.
Croulin complex	Croulin is a small settlement on the north coast of Knoydart. The surrounding area, stretching from Slisneach east to Creag an t-Sagairt, supports the largest area of ASNW surveyed. The main woods are on the north slopes of Meall na Coille Duibhe; between Allt na Criche and Allt Coire na h-Aisre; on the north and west slopes of Sgùrr na h-Aide; and along the Croulin Burn. Further relict woods are found in Coire na Circe and Coire na h-Aisre, and outlying woodland is found on the north side of Creag an t-Sagairt. There are 4 deer fenced blocks within the complex: Slisneach completed 2000, Cnoc Gorm and Croulin, both completed 2003, and Ben's completed 2022. Regeneration and planting within the earlier schemes have filled out and extended the woods there.	152 plots and 31 transects were surveyed and 143 notes taken.

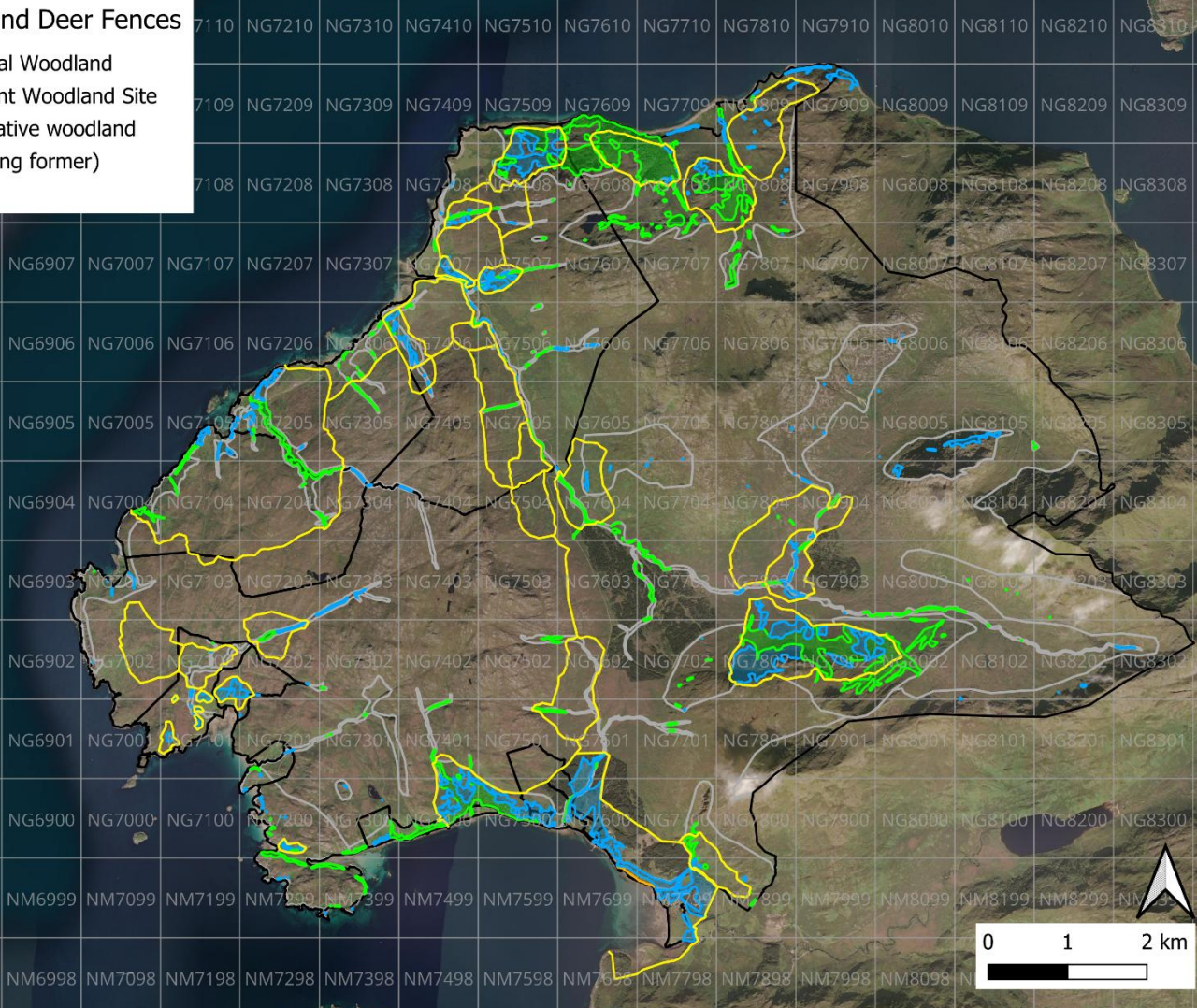
Map 1: Refuges

- Aioror Burn
- Allt a' Mhuilinn complex
- Allt na Faolin
- Allt Ruadh
- Abhainn Ghuserein complex
- Beinn na Caillich south
- Coire Each
- Creag na Ceàrdaich
- Croulin complex
- Doire Fhada and An Lagan complex
- Doune and Aioror coast
- Garsley
- Ladhar Bheinn
- Leathad Beag
- Leathad Mòr crags
- Rubha Raonuill to Tòrr Mòr complex
- Samadalan and Niag-àrd complex
- Sandaig Burn
- Scottas and Glaschoille complex
- Slochd a' Bhogha complex
- Upper Gleann na Guiserein
- survey area



Map 2: Woodland and Deer Fences

- Ancient Semi-Natural Woodland
- Plantation on Ancient Woodland Site
- other established native woodland
- deer fences (including former)
- survey area



3.2. How diverse is the survey area, and where is diversity concentrated?

Overall, tree diversity was high within the survey area, with wild populations of 20 different species recorded. However, only 4 species were common, accounting for 89% of established wild trees, while the remaining 16 totalled just 11%. Tree diversity was also unevenly distributed across the landscape, with diversity generally highest in less accessible areas at low altitude as shown in Figure 1 and Map 3. There is good potential to naturally enhance tree diversity across the landscape, as discussed in Section 3.4.

The most common wild trees were downy birch *Betula pubescens*, rowan *Sorbus aucuparia* and eared willow *Salix aurita*, comprising 55, 18 and 11% of the established wild tree total respectively. These were also the most widespread species, found at almost every refuge. Alder *Alnus glutinosa* was another common species, comprising 6% of the total, while hazel *Corylus avellana*, oak *Quercus sp.*, ash *Fraxinus excelsior*, dwarf willow *Salix herbacea*, hawthorn *Crataegus monogyna*, silver birch *Betula pendula* and juniper *Juniperus communis* were less common, together comprising 8%. Goat willow *Salix capraea*, holly *Ilex aquifolium*, bird cherry *Prunus padus*, grey willow *Salix cinerea*, wych elm *Ulmus glabra*, aspen *Populus tremula*, creeping willow *Salix repens*, and guelder rose *Viburnum opulus* were rare.

Key tree diversity hotspots were identified across the survey area. These included:

- The Scottas and Glaschoille complex, particularly along parts of the Scotas Burn. This was the most important refuge for ash, silver birch and hazel.
- The Sandaig Burn, Airor Burn, and Allt Ruadh. The Sandaig Burn was also the only refuge for guelder rose, and the Airor Burn important for ash and aspen.
- The Croulin complex, particularly the coast from Allt na Criche east to the old grazing enclosures, and the lower Allt Coire na h-Aisre. Croulin was the most important refuge for holly and probably elm.

Smaller hotspots were found in the wooded part of Slochd a' Mhogha, Creag na Ceardaich (important for goat willow), the Airor coast (important for grey willow), Allt na Faolin, and the Garsley Burn (main refuge for bird cherry). While tree diversity was generally lower elsewhere, some refuges were important for certain species and contribute significantly to diversity at landscape scale. These included Abhainn Inbhir Ghuiserein for alder, Beinn na Caillich south for juniper, and the Rubha Raonuill to Tòrr Mòr complex for aspen.

Both old and dead trees are also important components of diversity, with many invertebrates, lichens and fungi dependent upon them to complete their lifecycles. These old growth features were recorded widely in Ancient Woodland, with the greatest concentrations at Croulin and Garsley (mainly old and dead birch), Abhainn Inbhir Ghuiserein (old and dead alder), and the Airor Burn (mainly old birch, rowan and hazel).

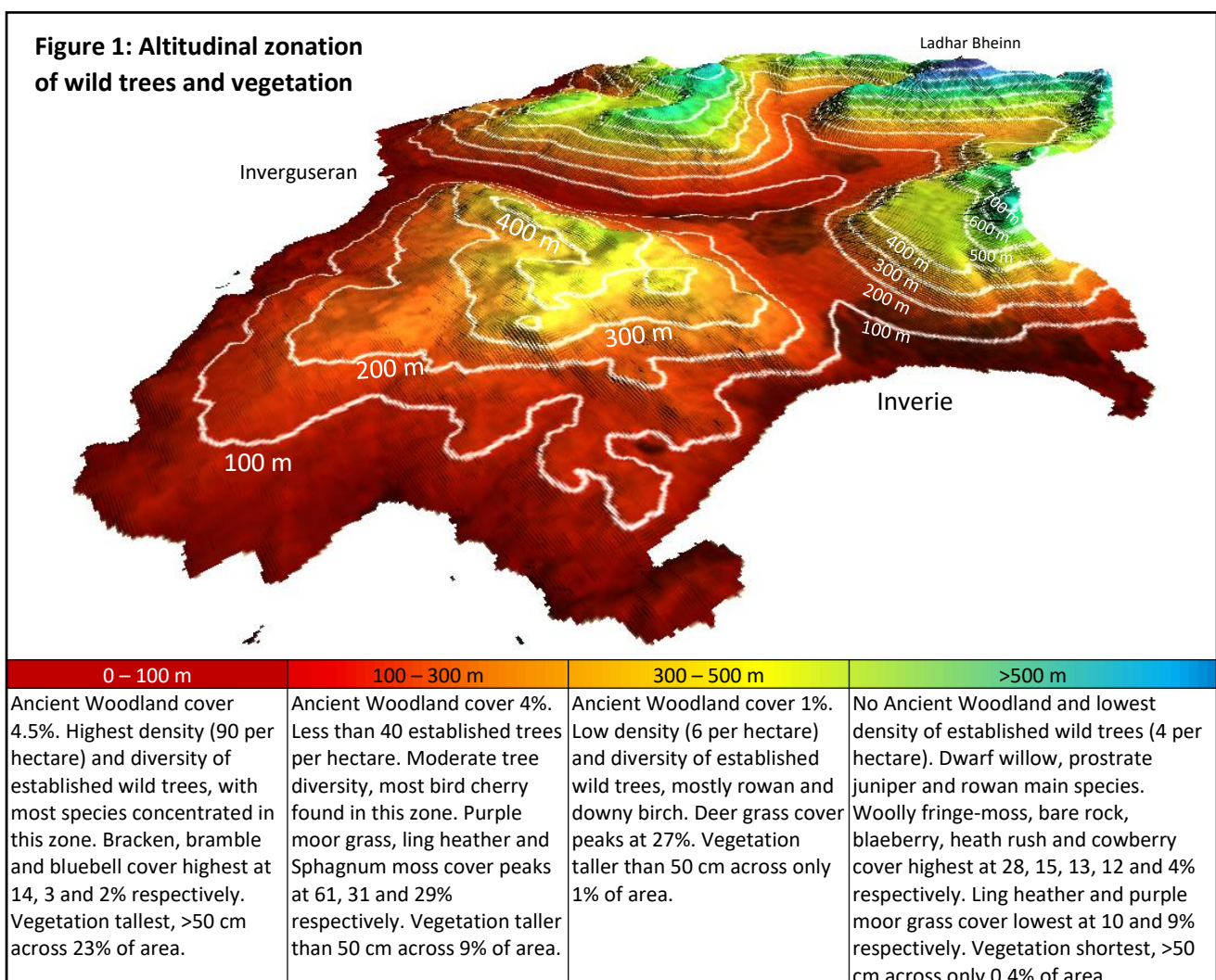
Vegetation across the survey area was dominated by purple moor grass *Molinia caerulea* (covering 46% of the ground), feather mosses (27%), ling heather *Calluna vulgaris* (25%), Sphagnum mosses (23%), deer grass *Trichophorum germanicum* (17%) and woolly fringe-moss *Racomitrium lanuginosum* (12%). Other significant components included tormentil (9%), smooth grasses and mat-grass *Nardus stricta* (9%), cross-leaved heath *Erica tetralix* (6%), bracken *Pteridium aquilinum* (5%), hare's tail cottongrass *Eriophorum vaginatum* (4%); blaeberry *Vaccinium myrtillus* (4%), bell heather *Erica cinerea* (3%), and heath rush *Juncus squarrosus* (3%). Note that total cover was greater than 100% because vegetation was often layered. Most vegetation was short, with 57% less than 20 cm in height. A further 33% was between 20 and 50 cm, and 9% was greater than 50 cm. Composition and structure of vegetation varied with altitude, as shown in Figure 1.

Refugial species³ diversity was also found to be high across the survey area with 101 different species recorded. The most extensive hotspots were found at the Scottas and Glaschoille and Croulin complexes, with additional hotspots in the steep-sided ravines that were distributed widely across the landscape, as

³ Refugial species are those that have retreated from the wider landscape into refuges due to pressures or habitat loss.

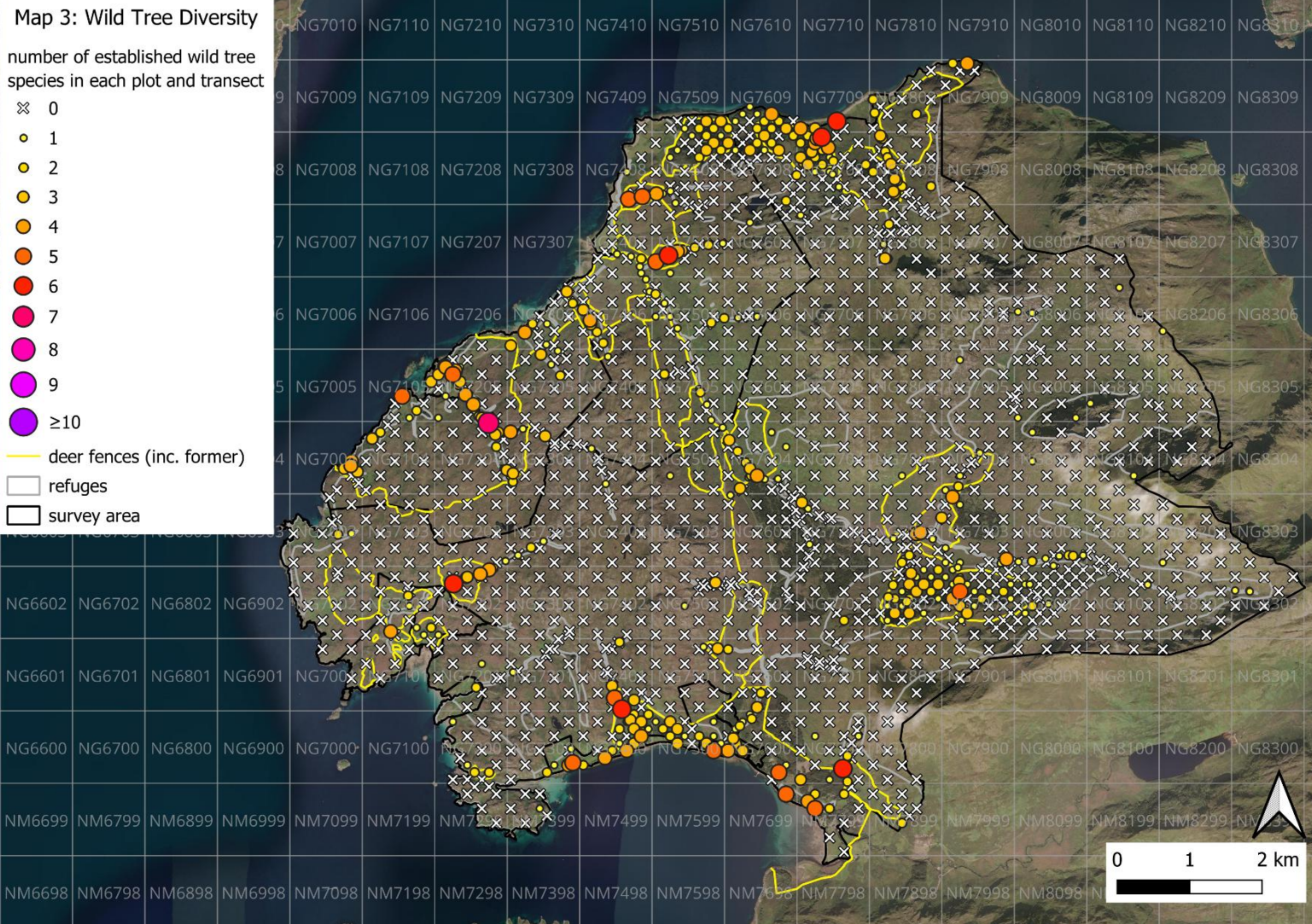
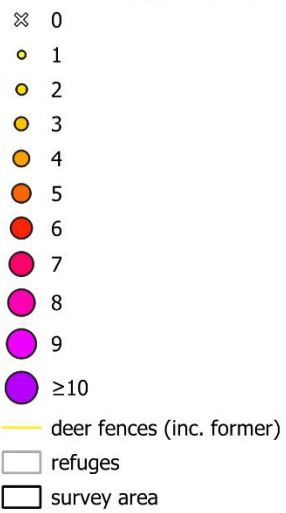
shown on Map 4. The most important refuges for rare species were the Croulin complex and Allt Ruadh. Several groups of refugial species were represented across the survey area, and notable species found:

- Many woodland wildflowers, best represented in low altitude ravines and at the Scottas and Glaschoille and Croulin complexes. Most notable were dog’s mercury *Mercurialis perennis*, only found along the Allt Ruadh; wild garlic *Allium ursinum*; and woodruff *Galium odoratum*.
- Rainforest associated plants and lichens, best represented at Scottas and Glaschoille, the Doune to Aior coast, the Aior Burn, and Allt Ruadh. Most notable were the specklebelly lichens *Pseudocyphellaria citrina*, *P. intricata*, and *P. norvegica* found in several new locations; the lichen *Sticta canariensis* at Glaschoille (brown morph) and the Croulin complex (green morph too); the lichen *Pyrenula laevigata* along the Aior Burn and Allt Ruadh; Tunbridge filmy fern *Hymenophyllum tunbrigense* at Allt Ruadh and the Croulin complex; hay-scented buckler fern *Dryopteris aemula*; and the gametophyte of Killarney fern *Vandenboschia speciosa*, found in a sea cave near Doune.
- Tall herbs, best represented on the crags and burns at Garsley, Coire Torr an Asgail, the Allt a’ Chairn Duibh off Màm Lì, and along the Sandaig Burn. Most notable was alpine saw-wort, which was particularly abundant in part of Coire na Diollaide on the north slopes of Ladhar Bheinn.
- Northern hepatic mat communities, best represented on the Garsley crags and Coire Each. Bird’s-foot earwort *Scapania ornithopodioides* was the most notable species.
- Other local rarities such as hard shield fern *Polystichum aculeatum*, dwarf cornel *Cornus suecica* and parchment lichen *Ricasolia amplissima*.



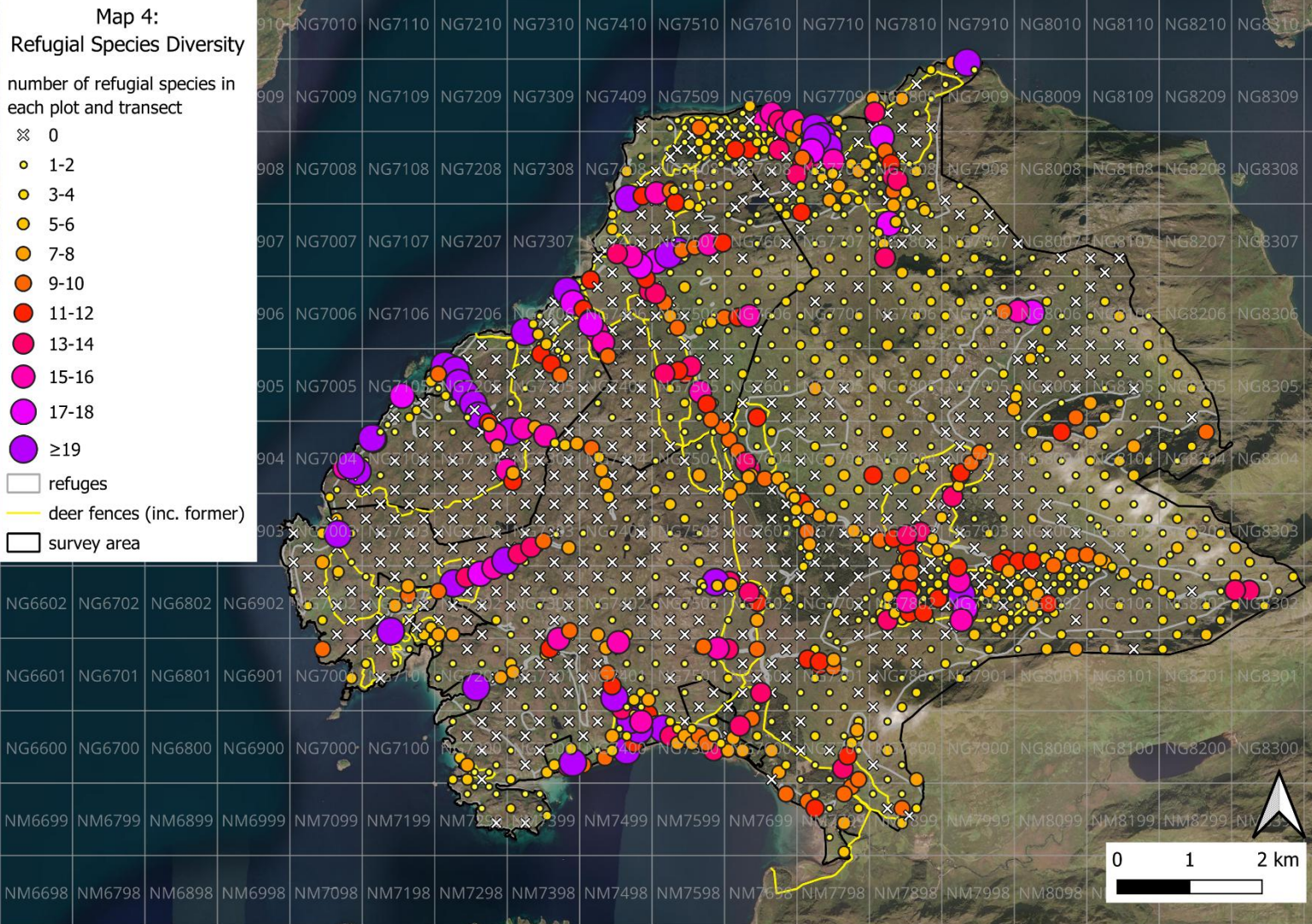
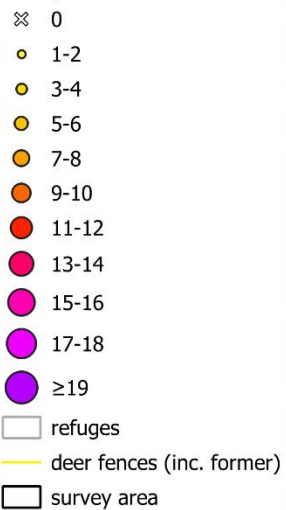
Map 3: Wild Tree Diversity

number of established wild tree species in each plot and transect



Map 4: Refugial Species Diversity

number of refugial species in each plot and transect





Dog's mercury carpeting the ground inside the Allt Ruadh, the only place this woodland wildflower was found during the survey



Tunbridge filmy fern, a rare rainforest species in the Highlands, growing at Allt Ruadh



Liverworts forming northern hepatic mat, a community of high-altitude rainforest and hyperoceanic heath



Early purple orchid



Sticta canariensis, a rare rainforest lichen, growing near Croulin



Roseroot amongst tall herb vegetation in Upper Gleann na Guiserein

3.3. Is diversity threatened, and where are the priorities for recovery?

A total of 300,000 established wild trees were estimated to occur across the survey area. The overall population structure was indicative of high levels of tree recruitment: 80% of established trees were at the maturing growth stage, 12% were mature, 8% were senescent⁴, and a further 5,700 were dead. There are two main reasons for this:

- Long-established, well-targeted deer fences enclose most Ancient Woodland across the survey area, and these have been proactively monitored for damage and incursions, with follow-up management undertaken where necessary. This has enabled successful natural regeneration to take place across key areas.
- Many refuges include steep-sided crags and ravines, which are naturally less accessible to browsing animals, allowing tree recruitment to take place even where pressures in the surrounding landscape remain high.

Despite these efforts, around 10% of semi-natural woodland was found to be critically threatened, with all established wild trees now senescent or dead. This rises to 33% outside fences, where successful recruitment was almost entirely confined to less accessible areas like crags and ravines. Loss of historical woodland was also identified in some areas. For example, the 1st OS map (surveyed 1873) depicts more extensive tree cover east and west of the Garsley fence than survives today.

Two main threats to diversity and barriers to recovery were identified during the survey. These were high levels of herbivore impact, particularly outside deer fences, and the spread of invasive non-native plants.

Herbivore impacts

Herbivore impacts were found to be high or greater across 49% of the survey area. High impacts were found more frequently outside deer fences (80% of the area outside fences) than inside (16%), with striking differences either side of the Black Hills fence (see Map 5). Sources of impacts varied from place to place:

- Red deer and, where present, sheep were considered the main source of impacts outside deer fences. Impacts from Sika deer may also be significant around the Guiserein plantation. Sheep were grazed on the hill from Inverguseran through Leathad Mòr and across Beinn na Caillich.
- Red deer were also considered the main source of impacts inside the Cnoc Gorm, Slisneach, Am Bidein and Garsley deer fences which have become porous.
- Feral goats were considered the main source of impacts in the southwest part of the Black Hills regeneration area. Their activity was concentrated along the coast from Rubha Raonuill to near Doune, where high impacts were also recorded. A few red deer remained inside the Black Hills fence and were causing locally significant impacts on the slopes above Samadalan.
- Sika and roe deer were considered the main source of impacts inside the Inverie fence. High impacts were concentrated on the slopes above Scottas. Likely roe deer activity was also noted within some of the smaller deer fenced compartments, such as the Sandaig Burn enclosure, but impacts in these areas was minor.
- Some compartments at Airor and Inverguseran were stock grazed, mainly by sheep.

Levels of browsing outside fences were sufficient to suppress the growth of tree seedlings across much of the landscape, preventing natural regeneration from taking place, except in less accessible areas. Patterns of recruitment indicate this has been the case for a long time. However, there were early signs that natural regeneration was becoming more established east of the Garsley fence and along parts of Abhainn Inbhir Ghuiserein due to reduced browsing pressure. Where significant impacts were found inside fences, browsing

⁴ Senescent trees are trees that have grown past maturity, often characterised by attached deadwood or signs of decay.

was typically concentrated on more palatable tree species like rowan, aspen, hazel and oak. If sustained over time, this could lead to reduced tree diversity in young developing woodlands. There were also some areas inside fences where browsing was sufficient to prevent further woodland expansion completely, particularly around Rubha Raonuill. In addition to impacts on trees, selective browsing outside and, locally, inside fences, was suppressing more palatable herbs and dwarf shrubs like blaeberry *Vaccinium myrtillus* and ling heather *Calluna vulgaris*. This can favour unpalatable grasses like purple moor grass *Molinia caerulea* becoming dominant.

Some deer fences are approaching the end of their lifespan, including the 31-year-old Garsley fence, 29-year-old Allt Ruadh and Allt na Faolin fences, and Niag-àrd, Slisneach, Cnoc Gorm, Croulin, Sandaig Chapel and Sandaig Burn fences, which are all over 20 years old. Although young trees have already become established in many areas, particularly on richer soils and at lower altitude, most fences also include areas where regeneration is still ongoing and therefore remains vulnerable to increases in herbivore impact as fences deteriorate. Regeneration and planted trees within the Allt Ruadh and Allt na Faolin fences are particularly vulnerable, as these have grown slowly due to exposure and soil conditions, and high-altitude regeneration at Garsley is also at risk now that the fence has opened. Increased impacts can also reverse ground vegetation recovery, with palatable plants like blaeberry and many refugial species reduced by selective browsing and grazing. Risks are lower within the Sandaig fences as these are inside the newer Black Hills fence.

Non-native plants

Invasive, non-native plants were spreading in some places, with 200,000 non-native seedlings estimated to occur across the survey area. As shown in Map 6, these were concentrated around:

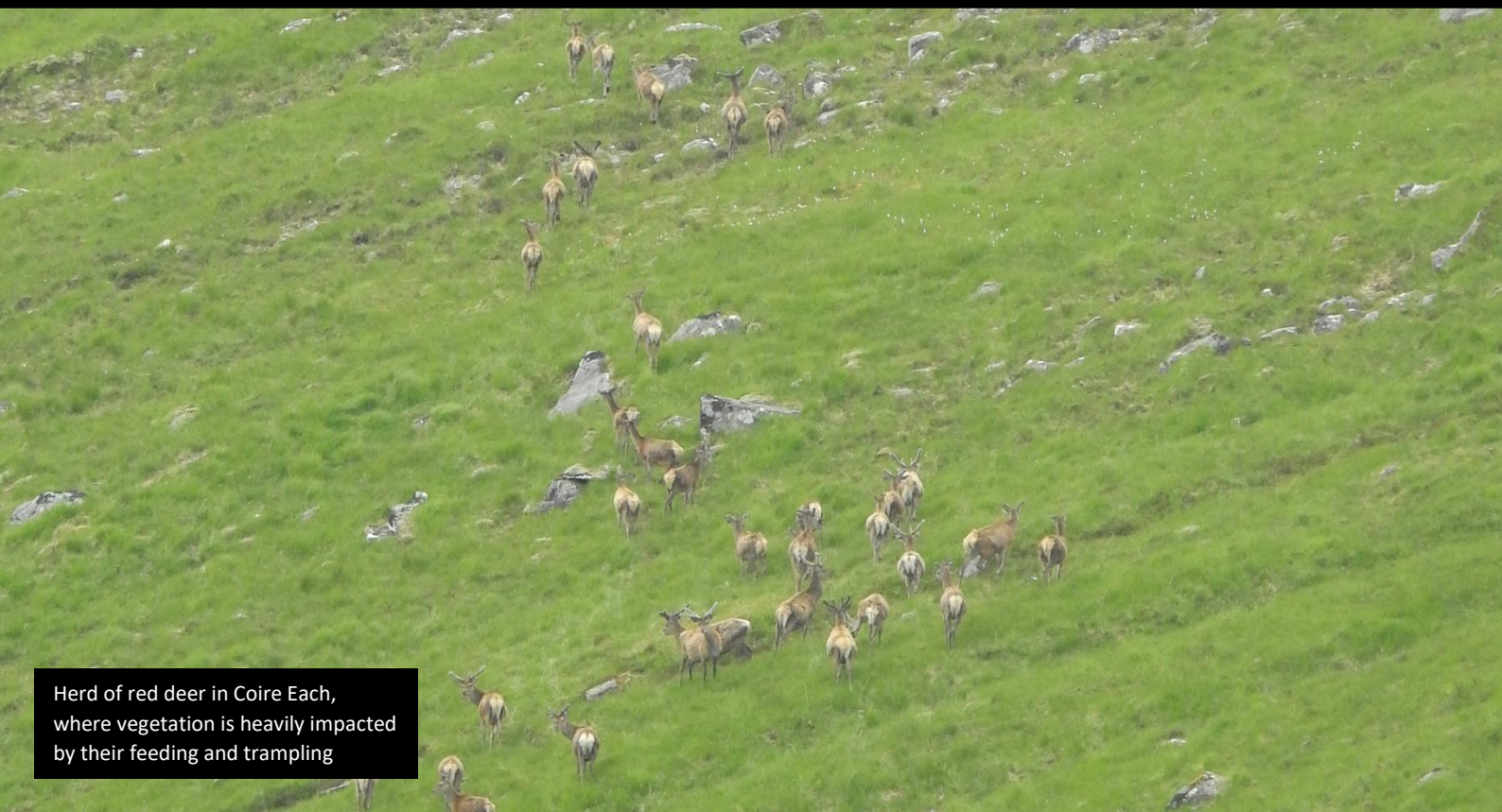
- Inverie, where non-native plants are associated with long-established plantations around the grounds of Inverie House, 20th century conifer plantations, and garden escapes. Around 65,000 non-native seedlings and 42,000 established trees and shrubs were estimated to occur inside the Inverie deer fence, along with additional herbaceous species. Of the established trees and shrubs, Sitka spruce *Picea sitchensis* was most abundant (56% of the total), followed by western red cedar *Thuja plicata* (21%), lodgepole pine *Pinus contorta* (5%), sycamore *Acer pseudoplatanus* (3%), western hemlock *Tsuga heterophylla* (2%), Himalayan honeysuckle *Leycesteria formosa* (2%), rhododendron *Rhododendron ponticum* (2%), tree cotoneaster *Cotoneaster sp.* (1%), and European silver fir *Abies alba*, beech *Fagus sylvatica*, hornbeam *Carpinus betulus*, lime *Tilia sp.*, larch *Larix sp.* and laurel *Laurus sp.* (each <1%). All species were observed to be regenerating except lime and larch, but western red cedar and Himalayan honeysuckle appeared to be spreading most vigorously, and sycamore, tree cotoneaster and rhododendron were starting to spread beyond Inverie. Other non-native plants included Monbretia *Crocsmia x crocosmiiiflora*, which has spread extensively along the shoreline, Chilean rhubarb *Gunnera tinctoria* near the mouth of Allt a' Mhuilinn, bamboo along the road at the base of Creag na Ceàrdaich, and shallon *Gaultheria shallon* within the plantation and regenerating clearfell below White Gate. Extensive efforts have already been undertaken to reduce rhododendron, and some former conifer blocks have been felled and allowed to regenerate as mostly-native woodland.
- The Guiserein and Folach conifer plantations, which were planted with lodgepole pine and Sitka spruce in the 20th century. Young conifers, primarily lodgepole pine, have seeded from these plantations into adjacent deer fenced areas, especially at Allt Bheag and Guiserein Bridge. Scattered lodgepole pine were also found far from seed source, including along the Airor Burn and within fences at Sandaig and Inverguseran.

- Near the settlement at Croulin, where butterfly-bush *Buddleja davidii* was spreading along the lower part of the Croulin Burn, and Montbretia has spread along the burn by the cottage.

Non-native plants can negatively impact wild trees and natural vegetation through competition for space and other resources. Overshading can also be an issue with rhododendron and some non-native conifers. Negative impacts across the survey area are currently localised, but these are likely to increase in future if non-native plants continue to spread and develop to maturity.



A photo taken along a fenceline at Cnoc Gorm. Natural regeneration is establishing inside the fence (right)

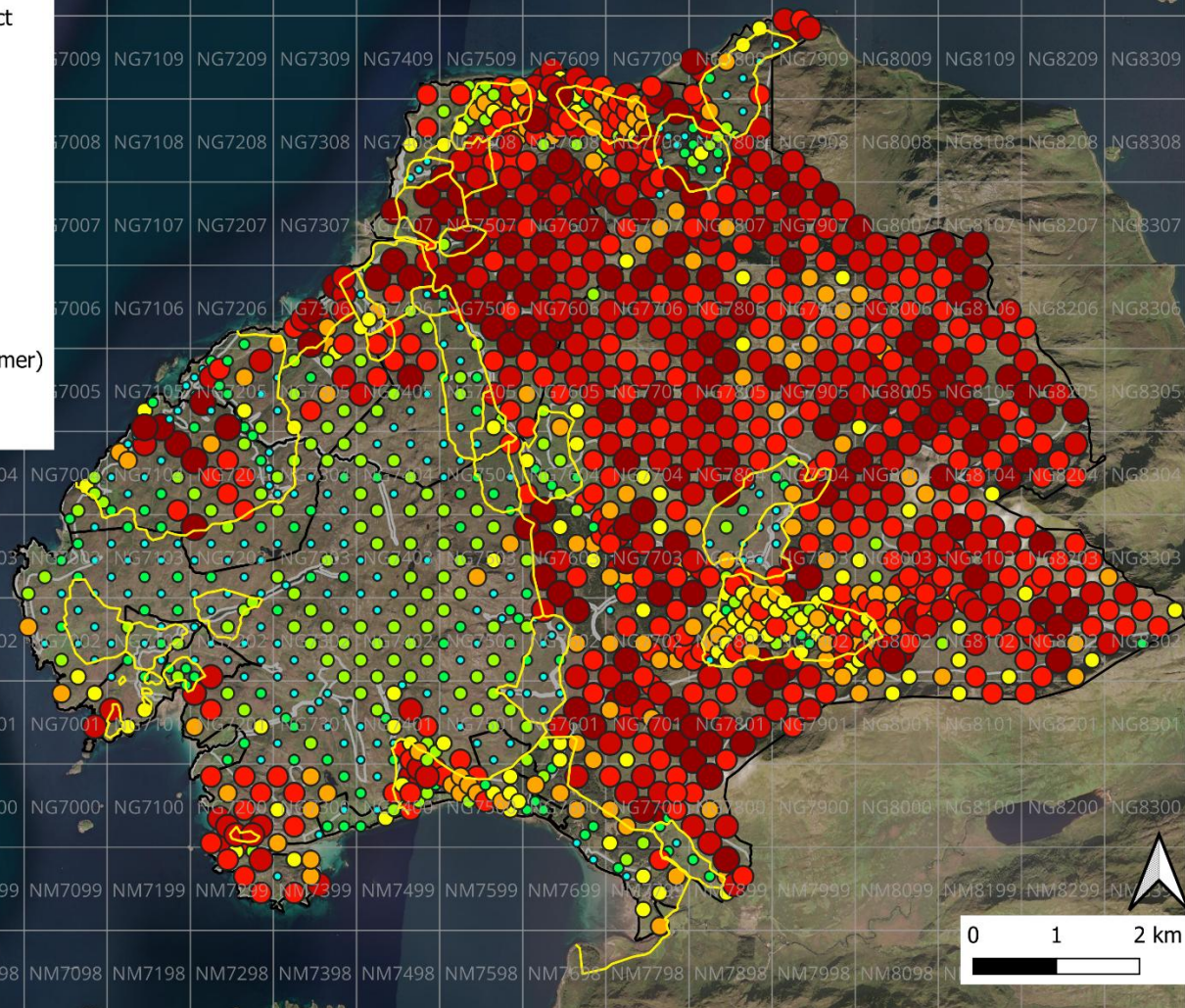


Herd of red deer in Coire Each, where vegetation is heavily impacted by their feeding and trampling

Map 5: Herbivore Impacts

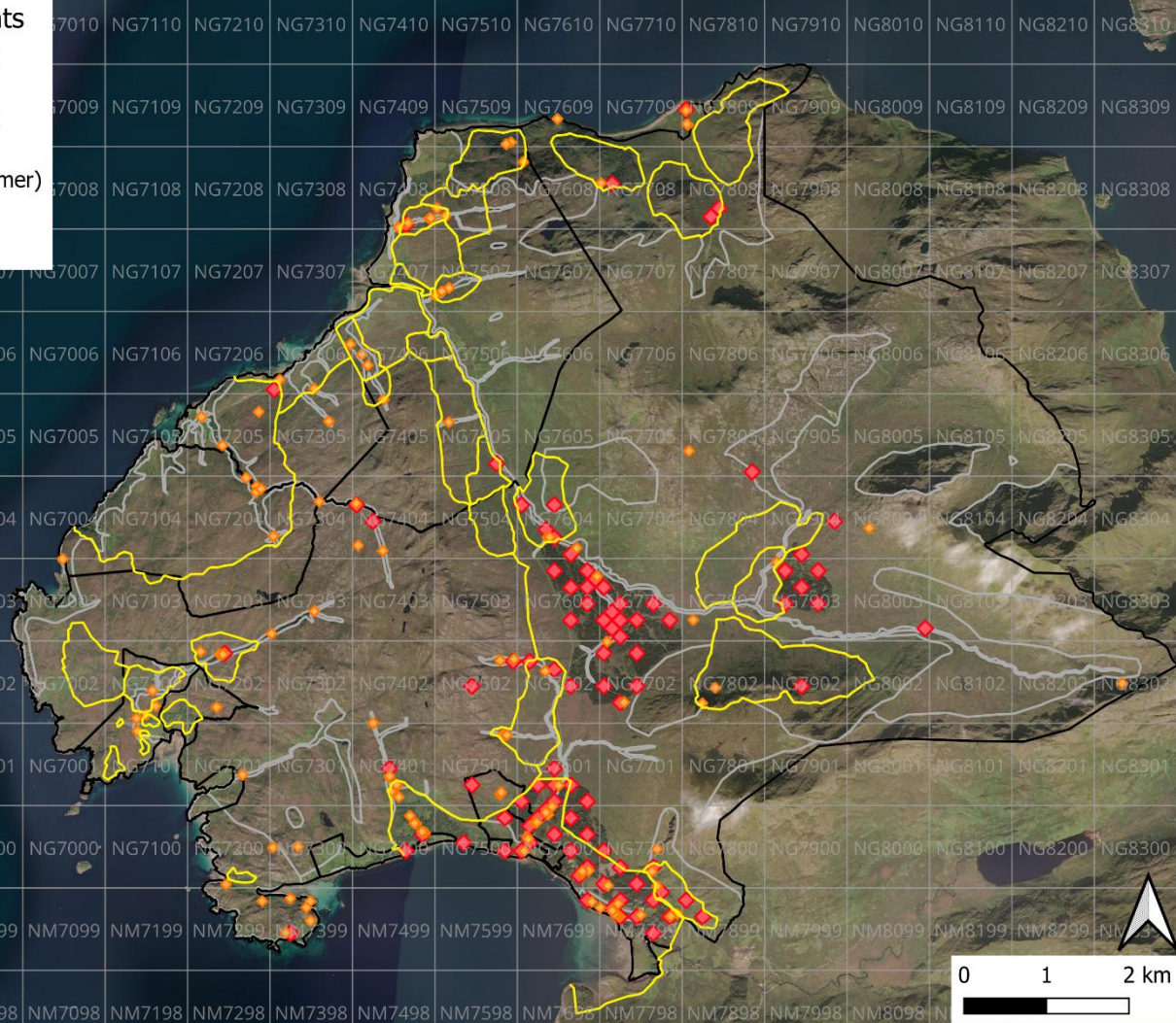
overall level of herbivore impact
(calibrated to woodland)

- absent
- low
- low to medium
- medium
- medium to high
- high
- high to very high
- very high
- deer fences (including former)
- refuges
- survey area



Map 6: Non-native plants

- non-native plant recorded in plot or transect
- non-native plant recorded outside plot or transect
- deer fences (including former)
- refuges
- survey area



Priority areas for recovery

Each refuge was assigned a priority level based on vulnerability and threats (see Appendix 2 for details). Priority areas for recovery are shown in Map 9.

Where diversity was assessed to be at a critical stage of decline, refuges were considered **very high** priorities for recovery. Ancient Woodland or wild tree populations were being lost from these refuges, which were characterised by poor recruitment, significant areas with only senescent and dead trees (see Map 7), and/or key species at imminent risk of extinction. 6 of the 21 key refuges were identified as **very high** priorities for recovery. These were:

- Parts of Abhainn Inbhir Ghuiserein and Allt Ruadh. Although recruitment was high overall at both refuges, some sections had declining wild tree populations and Ancient Woodland at risk of loss, with all established trees senescent or dead along around 20% of Abhainn Inbhir Ghuiserein and 33% of Allt Ruadh. The most threatened sections were the upper half of Allt Ruadh outside the deer fence, upper Allt an Drollaire, Abhainn Inbhir Ghuiserein around Priest's pool, and Allt Coire Torr an Asgaill upstream of the confluence with Allt Fearnna. The Guiserein conifer plantation also limits potential for recovery at Allt Doir a' Chaoruinn, and lodgepole pine was spreading along the river inside the Allt Bheag and Guiserein Bridge exclosures. However, deer fenced sections of both refuges were considered medium priorities for recovery, as described overleaf.
- Parts of the Croulin complex and Garsley. Although recruitment was high overall, accessible woodland outside fences was generally at a critical stage of decline. Where established trees or their remains were found, all individuals were senescent or dead in 14% of plots at the Croulin complex, rising to 33% outside fences, and 9% of plots at Garsley, rising to 80% outside fences. Recovery is an early stage within Ben's fence at Croulin, and so this remains very high priority, but recovery is more advanced in the Slisneach, Cnoc Gorm, Croulin and Garsley fences, so these are considered lower priority as described below.
- Samadalan and Niag-àrd complex. Although recruitment was high overall, accessible woodland fragments on the Common Grazing were generally at a critical stage of decline. The oak population also had chronically low recruitment across the refuge, and the hazel population was relictual with less than 50 individuals recorded.
- Leathad Beag, a small refuge with less than 50 surviving wild trees and populations dominated by senescent individuals.

Where diversity was at significant risk of decline, but decline had not reached a critical stage, refuges were considered **high** priorities for recovery. These were often characterised by moderate recruitment, minor areas with only senescent and dead trees (see Map 7), and/or key species at risk due to small populations or observed declines. Areas with abundant non-native species were also included if these presented a significant near-term threat. 7 refuges and 2 deer fenced areas within refuges were identified as **high** priorities for recovery. These were:

- The Airor and Sandaig Burns, where recruitment was high overall, but some key species were threatened and localised woodland decline taking place. The key species were ash along the Airor Burn, threatened by dieback, and guelder rose along the Sandaig Burn, which has a very small population size of 2. Localised woodland decline was recorded along part of Allt na Teanga Meadhonaich, a tributary to the Airor Burn, and along parts of the upper Sandaig Burn, but recovery is expected to take place over time under current management as natural regeneration advances. Non-native species were also recorded along both burns, with rhododendron spreading vigorously along the Sandaig Burn at NG724028 and lodgepole pine and sycamore colonising the Allt a' Choire Sheilich tributary to the Airor Burn.

- Creag na Ceàrdaich and the Allt a' Mhuilinn complex, where recruitment was high but non-native species were widespread, abundant and spreading. At Creag na Ceàrdaich, there were around 460 established and 850 regenerating non-native trees and shrubs per hectare, while at Allt a' Mhuilinn the respective densities were 110 and 140 per hectare, but these were concentrated along the river inside the Inverie fence so were higher locally. Ancient Woodland decline was also noted along the Allt Leac nan Caiseachan, a tributary to the Allt a' Mhuilinn, with remaining trees senescent or dead except along the steepest ravine sections.
- Coire Each and Upper Gleann na Guiserein, which support some of the highest altitude areas of relict woodland found during the survey. While dominated by rowan, downy birch also formed an important component and was threatened, with small populations and relatively low recruitment.
- The Doire Fhada and An Lagan complex, where woodland was very relictual and wild tree populations were small but recovering. Non-native sycamore regeneration was also recorded.
- Within the Garsley fence, where the small population of bird cherry was dominated by older trees, and high-altitude regeneration were at risk from increasing herbivore impacts.
- Within the Cnoc Gorm and Croulin fences at Croulin. Oak and elm populations were dominated by older trees at Cnoc Gorm, with oak regeneration being selectively browsed by deer inside the fence. Woodland decline was noted in higher altitude areas within the Croulin fence, but regeneration was taking place and will establish over time if the fence remains effective.

Where diversity was stable or improving, but pressures were still preventing potential from being realised, refuges were considered **medium** priorities for recovery. 7 refuges and deer fenced areas within another 2 refuges were assessed as **medium** priorities for recovery. These were:

- The Rubha Raonuill to Tòrr Mòr and Scottas and Glaschoille complexes, where levels of herbivore impact remained a barrier to recruitment of palatable tree species and, in some areas, woodland expansion. Invasive rhododendron was also spreading at Rubha Raonuill, and several non-native trees and shrub species are in the process of establishing at Scottas.
- The Leathad Mòr crags, Beinn na Caillich south, Slochd a' Mhogha complex, and Allt na Faolin, where levels of herbivore impact remained a barrier to woodland expansion, except within the Guiserein Bridge, White Gate and Allt na Faolin fences. Rhododendron was also recorded at Slochd a' Mhogha and Allt na Faolin.
- Ladhar Bheinn, where levels of herbivore impact were preventing tall herbs and dwarf shrubs from spreading and limiting growth and flowering.
- Deer fenced sections of Abhainn Inbhir Ghuiserein and Allt Ruadh, including within the Guiserein Bridge, Abhainn Beag, Abhainn Beag Mòr, and Allt Ruadh exclosures, where lodgepole pine was spreading.
- Within the Slisneach fence at Croulin, where selective browsing was suppressing regeneration of palatable tree species and starting to reverse recovery of palatable ground vegetation.

Recovery was already advanced and woodland expanding without significant pressures at the last refuge, Doune and Airor coast, so this area was considered a **low** priority for recovery.

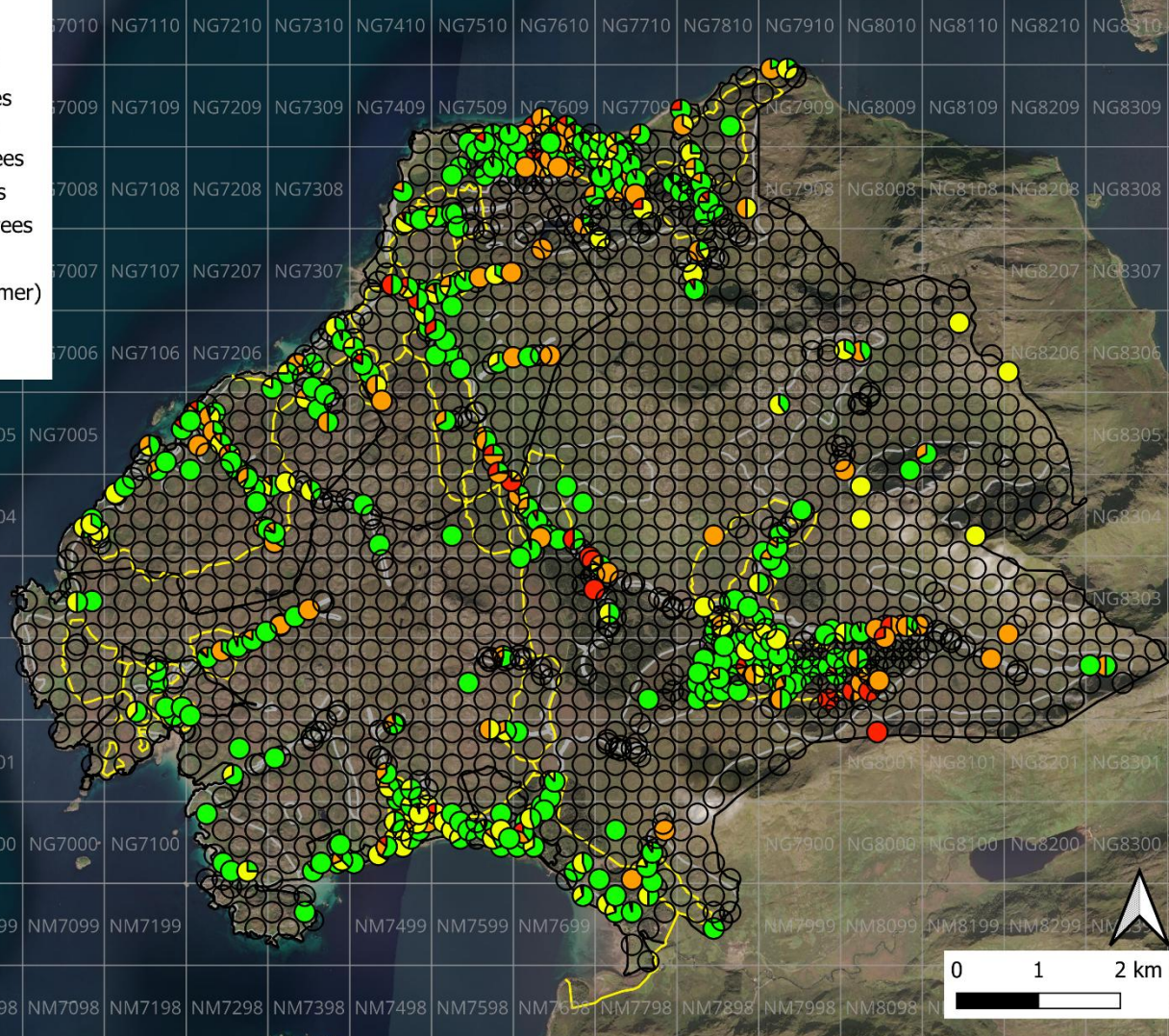
Wild tree species priorities

Some wild tree populations were threatened as their population sizes were small across all refuges, or because of widespread recruitment failure. Those with small population sizes include bird cherry, grey willow, wych elm, aspen, creeping willow and guelder rose. The ash population was also threatened by ash dieback caused by the invasive pathogen *Hymenoscyphus fraxineus*. These species are considered priorities for recovery.

Map 7: Wild Tree Population Structure

growth stages of wild trees within plots and transects

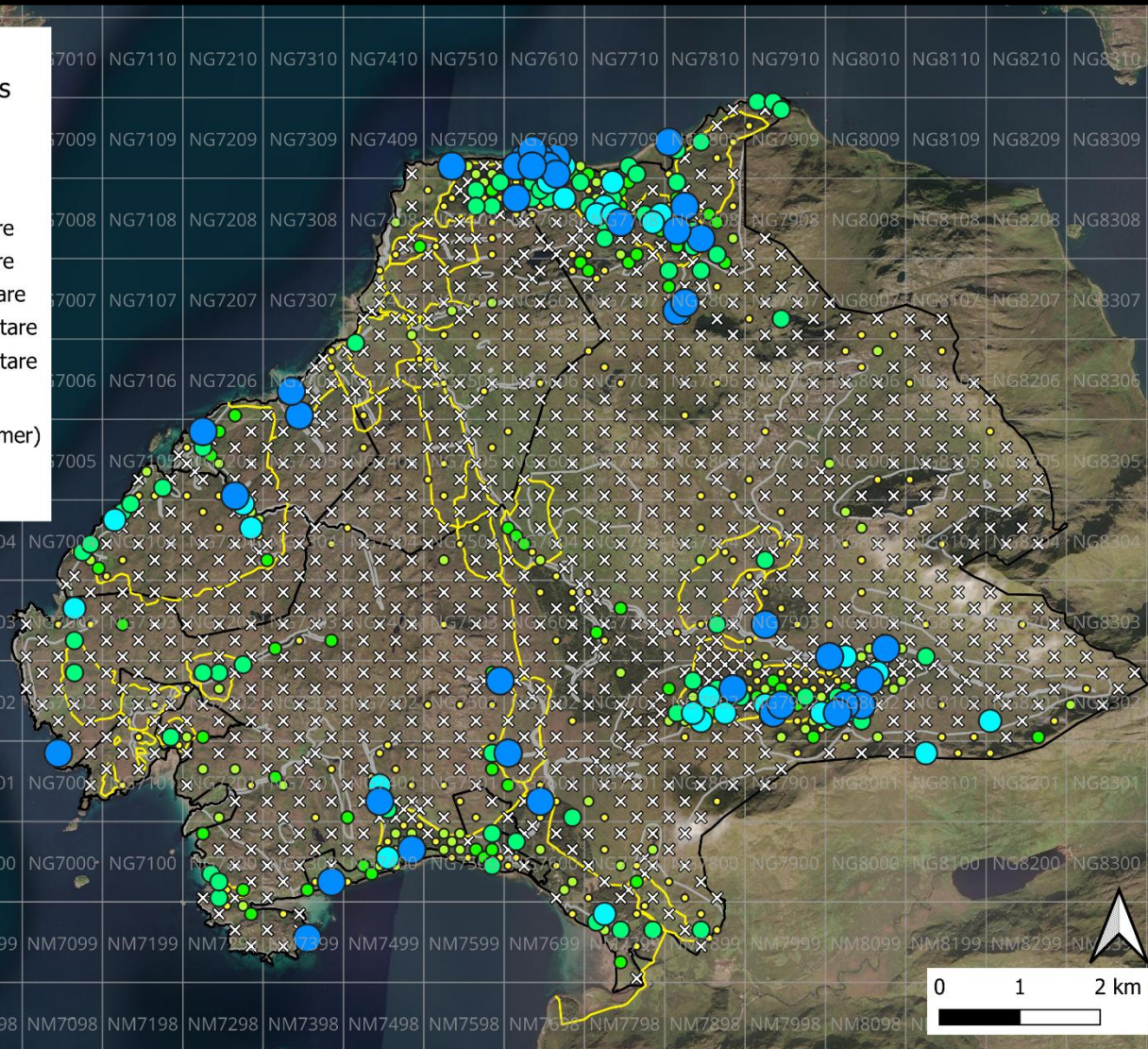
- proportion of maturing trees
- proportion of mature trees
- proportion of senescent trees
- proportion of dead trees
- deer fences (including former)
- refuges
- survey area



Map 8: Natural Regeneration Densities

density of native regeneration (scaled from subplots)

- ⊗ 0 trees per hectare
- 100 - 300 trees per hectare
- 400 - 600 trees per hectare
- 700 - 1000 trees per hectare
- 1100 - 2000 trees per hectare
- 2100 - 3000 trees per hectare
- >3000 trees per hectare
- deer fences (including former)
- refuges
- survey area





Thinly scattered old and trees around Allt Ferna at Garsley, an area depicted on an estate map as woodland in the 1850s



Woodland surviving in the gorge of the Airor Burn, where inaccessibility allowed recruitment to continue even when pressures in the surrounding landscape were high. Seedlings are starting to spread out from the gorge now that herbivore impacts have been reduced.

3.4. What is the potential for natural recovery across the survey area?

Regenerating and expanding wild tree populations naturally helps to maintain the genetic diversity, distinctiveness, and structural variability that characterises many of Scotland's Ancient Woodlands and contributes to their health and resilience. Natural regeneration is a dynamic process, and it can be difficult to estimate how much is likely to take place in different areas ahead of time. However, seedlings generally cluster around existing trees, where seed rain is greatest and ecto-mycorrhizal networks are well established. When browsed, these can build up over time, forming aggregations of tiny, stunted trees. The distribution and density of seedlings can give an indication of the likely short term regeneration response if pressure was lowered. During the survey, existing seedling densities were recorded within subplots at refuges and across the wider landscape.

Based on seedling densities shown in Map 8, around 1.5 million native trees and shrubs have potential to establish through natural regeneration across the survey area. Around 880,000 of these were inside deer fences, while 670,000 were outside. As expected, densities were found to be higher within existing woodland, with an average of over 1000 seedlings per hectare in Ancient Woodland and 630 seedlings per hectare in other established native woodland, indicating high potential for natural recovery. Relatively high densities were also found within 50 metres of woodland, with an average of 420 seedlings per hectare recorded, and between 50 and 100 metres, where average density was 240 seedlings per hectare. Beyond 100 metres, the average density was 80 seedlings per hectare. Despite these varying densities, the number of seedlings in existing woodland, within 100 metres of woodland, and beyond 100 metres was roughly the same due to the different sizes of each zone, with around a third of the total found in each.

Woodland expansion

The survey area supports around 420 hectares of established native woodland, including around 240 hectares of Ancient Woodland. There is potential for significant natural woodland expansion from these areas as shown in Map 10:

- If tree cover expanded 50 metres from the woodland edge, up to 780 hectares of additional woodland could develop, with seedlings already present across an estimated 380 hectares.
- If tree cover expanded by 100 metres, a further 770 hectares of woodland could develop. Seedlings were already present across an estimated 270 hectares between 50 and 100 metres from the woodland edge.

Natural woodland expansion is already underway in some areas following reductions in levels of herbivore impact, particularly inside the Slisneach, Cnoc Gorm, Croulin and Garsley fences, and along the Airor coast, where young birch, rowan and eared willow are establishing widely beyond relict woodland. Significant woodland expansion is also starting to take place along parts of the coastal strip within the Black Hills fence, including at Glaschoille where additional species like oak, hazel and ash are spreading.

Based on the distribution and abundance of suppressed regeneration, potential to secure rapid natural woodland expansion appears to be highest in the following areas:

- Along Abhainn Inbhir Ghuiserein, where alder seedlings were found to be widespread. Reducing herbivore impacts along the river could allow more riparian woodland to develop, improving freshwater habitats for fish and invertebrates, and providing shade to help buffer against temperature extremes. Additionally, wild bird cherry may spread from its connected refuge along the Garsley Burn.
- At Croulin, particularly between the Slisneach and Cnoc Gorm fences, in Coire na h-Aisre, and around unfenced sections of the Croulin Burn, where birch and rowan seedlings were widespread. Over

time, other species including oak and hazel may also spread from within the Cnoc Gorm fence to areas where soil conditions are suitable.

- East Garsley, from the slopes of Meall an Uillt-fherna to Allt Coire Torr an Asgaill, where birch, rowan and eared willow seedlings were locally abundant.
- The coast from Rubha Raonuill to Tòrr Mòr, where oak, birch, rowan and eared willow seedlings were relatively widespread and moderately abundant, and aspen was suckering locally.

Significant potential for natural expansion of trees and shrubs also exists further than 100 metres from existing woodland, with natural regeneration recorded across a further 1050 hectares. This typically comprises rowan or eared willow seedlings growing at low densities. Once established, these could in turn act as loci for further woodland development in future, particularly as eared willow can support development of ecto-mycorrhizal networks beneficial to birch and many other tree species. Additionally, denser areas of natural regeneration would be expected to develop along the upper Abhainn Bheag and Allt Coire Each if pressures were lower, as these rivers support exposed gravel banks and mineral soils highly suitable for colonisation by birch and pine.

The survey area also supports significant areas of deep peat which form blanket bog habitat, important for a range of specialised species. While natural woodland development in these areas is unlikely, healthy blanket bogs can support scattered cover of certain trees and shrubs. These include Scots pine and downy birch, which typically grow extremely slowly in the nutrient-poor waterlogged peats. Woodland development can be further constrained at high altitude, where exposure and harsh climatic conditions favours a mosaic of patchy tree cover and montane scrub. While most trees were found at altitudes below 350 m across the survey area, pockets of woodland and scattered birch and rowan occurred much higher. Established birch was recorded to 470 m above sea level, and established rowan to 660 m. Prostrate juniper and dwarf willow, which can be components of montane scrub, were found higher still. If pressures were sufficiently reduced, these species would be expected to spread at high altitude, probably along with stunted Scots pines, tall herbs, and dwarf shrubs like bog blaeberry *Vaccinium uliginosum*.

Diversity potential

Wild tree and refugial species diversity was high but heavily concentrated in less accessible hotspot areas, as described in Section 3.1. These hotspots were widely distributed, and most wild tree and refugial species populations within them were reproductively viable. As a result, there is good potential for diversity to spread from hotspots into the wider landscape, where pressures are sufficiently lowered. Some evidence of this was found inside deer fenced areas, with examples including:

- Young hazels found growing in accessible sections of the Garsley Burn within the Garsley fence, whereas old hazel was confined to inaccessible areas. Some grazing-sensitive refugial species like beech fern were also widespread within the fence, whereas outside they were confined to crags.
- Young oak and holly were found growing widely within the Cnoc Gorm fence, while parent trees were more restricted to ravines and crags.
- Tall herbs like water avens and melancholy thistle were becoming locally abundant within parts of the Black Hills fence.

The long-term composition of developing woodland would also be influenced by soils, altitude and climate. On more base-rich soils, trees like hazel, ash, wych elm, goat willow, and bird cherry have potential to become more prominent, and flowering herbs are likely to make up a greater proportion of the vegetation. Indicators of base-rich soil were found more commonly on south-facing slopes, including around Slochd a' Mhogha, Scottas and Glaschoille, and at Leathad Beag and Mòr. On acidic soils, trees like sessile oak and Scots pine have potential to become more prominent, and dwarf shrubs are likely to make up a greater



Hazel, oak and birch regenerating through dense bracken at Glaschoille following reductions in herbivore impacts

proportion of the vegetation. Indicators of acidic soils were generally more widespread on north-facing slopes. Many wild tree populations also have potential to spread upslope from lower altitude refuges. These include oak, ash, elm, hazel and alder, which were mostly found close to sea level across the survey area but can grow above 300 m where conditions are suitable.

There is also potential for tall herbs and dwarf shrubs to grow and spread beyond woodland. For example, dwarf shrubs like ling heather and blaeberry were widespread but generally suppressed by heavy browsing outwith fences, particularly at high altitude. These would be expected to increase in cover if herbivore impacts were reduced, forming extensive high-altitude heaths in areas currently dominated by grazing-resistant mat-grass and heath rush. Tall herbs like globeflower, melancholy thistle and alpine saw-wort would also be expected to increase, particularly in areas with more base-rich soil, increasing the extent of tall herb vegetation beyond relict stands found on inaccessible ledges.



Critically threatened Ancient Woodland dominated by old and dead trees between the Slisneach and Cnoc Gorm fences



Ancient Woodland recovering below the Cnoc Gorm fence due to reduced levels of herbivore impact



Simple vegetation dominated by mat-grass and heath rush above Coire Torr an Asgail. This has low ecological productivity due to the scarcity of insect-pollinated and berry-producing plants.



A photo taken along the top of the Garsley fence. Outside the fence (left) vegetation is simple and dominated by purple moor-grass, while ling heather has grown and spread inside (right). This illustrates the potential for ecologically productive vegetation to spread beyond woodland if herbivore impacts can be sufficiently reduced.

4. Management recommendations

Based on the findings presented in this report, and with consideration of the health and resilience characteristics summarised in Section 2.1, Trees for Life makes the following recommendations to land managers to help guide ecological recovery and realise the ecological potential of the landscape. While social and economic considerations are beyond the scope of this report, land managers should also take these into account in decision making. Recommendations are summarised by refuge in Table 2.

1. **Maximise recovery through natural regeneration and expansion.** There is good potential for natural recovery across the survey area as described in Section 3.4, with potential to establish 1.5 million trees and shrubs through natural regeneration based on existing seedling densities, and scope for significant natural woodland expansion. Focusing efforts on regenerating and expanding wild tree populations naturally helps maintain the genetic diversity, distinctiveness, and structural variability that characterises many of Scotland's Ancient Woodlands and contributes to their health and resilience.
2. **Progress towards effective landscape-scale deer management⁵.** Despite 30 years of efforts to restore and expand woodlands across the survey area using deer fencing, levels of herbivore impact remain the main threat and barrier to recovery across much of the landscape, as described in Sections 3.3 and 3.4. Transitioning from a fence-based to landscape-scale approach to deer management is recommended for 3 main reasons:
 - *To maximise recovery and realise ecological potential.* Evidence from elsewhere in the Highlands suggests that reducing deer populations to around 2/km² is required to achieve full recovery of woodlands, although benefits may also be seen at 4/km² or higher depending on local factors. This allows diverse tree regeneration to take place over large areas and palatable vegetation to spread. In turn, this enhances diversity and continuity across refuges, maximises mobility, and strengthens connectivity over time. There are also benefits for a range of other habitats, including peatlands, montane scrub, riparian areas, and tall herb vegetation.
 - *To overcome limitations of deer fencing.* Deer fencing has been an integral part of deer management across the survey area, initiating recovery and expansion of many areas of Ancient Woodland and enabling planting schemes to be carried out. Fences have been frequently monitored, with repairs undertaken where needed and responsive management of deer or livestock that get inside. However, even well-maintained fences have a finite lifespan and may not last long enough for regeneration to establish fully, particularly on low-nutrient soils and at higher elevation. This is becoming an issue in some areas, with the 31-year-old Garsley fence no longer maintainable and high-altitude regeneration now at risk. Regeneration and planted trees within the 29-year-old Allt Ruadh and Allt na Faolin fences are also particularly vulnerable, as these have grown slowly due to exposure and soil conditions. Once fences are breached, ground vegetation recovery is often also reversed, with palatable plants like blaeberry and many refugial species reduced by selective browsing and grazing. Fencing is therefore best thought of as a temporary solution on the road to effective landscape-scale deer management, with sustained recovery and improved resilience ultimately dependent on management transitioning within the lifespan of the fence.
 - *To support habitat recovery across the peninsula more widely.* Wild Trees Surveys have been carried out across other parts of the Knoydart peninsula [13,15,19, 20]. These have documented extensive areas of critically threatened Ancient

⁵ Effective landscape-scale deer management means reducing deer densities to a level that allows diverse tree regeneration and vegetation recovery to take place outside fences.

Woodland and Caledonian Pinewood, including within Glen Barisdale SSSI and at Glen Barisdale, Loch Hourn, and Lochourn River CPI sites. High levels of herbivore impact from deer have been identified as the main driver of decline and barrier to recovery. Given the scale of the issue, a landscape-scale approach to deer management would ultimately be required if widespread loss of irreplaceable woodland is to be avoided. This can be achieved more easily and successfully where neighbouring land managers align priorities and cooperate.

3. **Maximise effectiveness of existing deer fences.** Significant levels of herbivore impact were recorded within some of the existing deer fences across the survey area, as described in Section 3.3.
 - Impacts pose a threat to establishing regeneration inside the Cnoc Gorm, Slisneach, Am Bidein and Garsley fences, where red deer were the main source. It would be beneficial to remove red deer from within the Cnoc Gorm, Slisneach and Am Bidein fences and carry out fence maintenance and repair where required. Removal is not possible within the Garsley fence as a section has been taken down, but continuing focused deer management efforts in this area may allow more regeneration to establish successfully, particularly at high altitude, and safeguard recovery of palatable plants in the field layer.
 - Impacts were also a barrier to recovery locally within the Black Hills and Inverie fences, with feral goats the main source in the southwest Black Hills, red deer on the slopes above Samadalan, and sika and roe deer on the slopes above Scottas. To secure recovery and expansion of coastal woodland and important aspen stands in the southwest Black Hills, impacts from feral goats would have to be significantly reduced. This may happen without intervention if recruitment within the herd is sufficiently low, or could be achieved through culling or relocation. It would also be beneficial to remove red deer from the slopes above Samadalan and increase stalking of sika and roe deer above Scottas.
 - There is a risk that other deer fences will become porous over the next few years. It is recommended that fence condition and impacts within fences continue to be monitored frequently, with repairs carried out promptly where needed and deer pressure reduced where appropriate.
4. **Consider whether new fencing should be used in critically threatened areas.** Wild tree populations and Ancient Woodland are most threatened outwith fences along parts of Abhainn Inbhir Ghuiserein, Allt Ruadh, the Croulin complex, Garsley, the Samadalan and Niag-àrd complex, and Leathad Beag, as described in Section 3.3. Depending on whether and how quickly effective landscape-scale deer management progresses, there may be a role for deer fencing in these areas to initiate recovery. If additional fencing is considered further, it is recommended that the whole of the woodland and a surrounding natural expansion zone of at least 50 m is included where possible. Fencing effectiveness also depends upon frequent monitoring, prompt repairs and responsive management of any deer or livestock that get inside. However, deer fenced enclosures are only ever a stopgap solution, with sustained recovery and improved resilience ultimately depending on the transition to landscape scale deer management being made.
5. **Consider managing hill sheep access to sensitive areas.** Sheep are grazed on the hill from Inverguseran through Leathad Mòr and across Beinn na Caillich. At present, herbivore impacts are generally too high in these areas for regeneration to establish successfully, which threatens wild tree populations and Ancient Woodland in some refuges, including parts of Abhainn Inbhir Ghuiserein, Allt Ruadh, and Leathad Beag. Levels of impact are also a barrier to expansion at Leathad Mòr. These impacts may be somewhat reduced if landscape-scale deer management is implemented, but it is likely that browsing by sheep at current stocking levels would remain too heavy for regeneration to take place successfully. One option to facilitate recovery in these places would be to contain sheep to less sensitive areas through livestock fencing or no-fence collars.

6. **Consider strategic grazing to accelerate recovery and maintain habitat for sensitive species.** When levels of herbivore impact are reduced, thickening and growth of vegetation can become a barrier to regeneration in certain circumstances, particularly on fertile soils, at low altitude, and on south-facing slopes further from tree seed sources. Periodic disturbances in these areas can create new regeneration niches for seed to germinate and seedlings to establish. One way of achieving this is through pulses of cattle grazing, as cattle are heavy underfoot so create pockets of bare soil as they move around, and the way that they graze tends to reduce dominant species. It may be beneficial to trial pulse grazing of cattle on the slopes above the woodland at Scottas, where bracken is relatively tall and dense. It would be important to monitor changes in herbivore impacts and the density and height of regeneration to establish whether the intervention was having the desired effect.

Appropriate cattle or horse grazing can also be applied to maintain and enhance species-rich grasslands and heaths. This could be beneficial on the coastal fields beside Croulin, where greater butterfly orchids *Platanthera chlorantha* were recorded (currently the only known site on Knoydart west of Kinlochhourn). Winter grazing is the best form of management for this species. Maintaining existing summer cattle grazing on the Common Grazing at Samadalan is also beneficial for the lesser butterfly orchid *Platanthera bifolia* population that occurs there. Stocking densities should be informed by annual herbivore impact assessment, with the aim of ensuring impacts remain low enough for oak regeneration to occur successfully at Samadalan.
7. **Remove conifer plantations.** Lodgepole pine is spreading from the Guiserein and Folach conifer plantations, degrading adjacent refuges and posing a potential disease risk to nearby Scots pine through *Dothistroma* needle blight. These plantations also attract high deer densities, including invasive sika deer. The dense conifer cover makes them difficult to manage and so can create a reservoir for deer impacts elsewhere. Harvesting Guiserein and Folach conifer plantations would remove the non-native seed source, reduce disease risk to Scots pine, and enable more efficient deer management. Both areas would be expected to naturally regenerate as birchwood if herbivore impacts were sufficiently reduced and non-native conifer regeneration managed.
8. **Undertake wider non-native species control.** While negative impacts from non-native plants are currently localised, there is potential for these to spread and intensify in future, with an estimated 200,000 non-native tree and shrub seedlings and several invasive herbaceous plants found across the survey area as described in Section 3.3. It is recommended that non-native plant control and eradication projects be developed, with a focus on key areas including Inverie, Abhainn Bheag, Guiserein Bridge and Croulin. These would build on work that has already been successfully carried out to reduce invasive rhododendron. Management would be relatively straightforward at Abhainn Bheag and Guiserein Bridge where lodgepole pine is the main issue, and at Croulin where non-native species are not widespread. The challenge is however much more complex at Inverie due to the diversity of invasive plants present and scale of their spread. Species that could initially be prioritised for eradication include shallon, cotoneaster and Himalayan honeysuckle, as these can all be dispersed over long distances by birds, and shallon grows in the kind of acidic woodland that is widespread on Knoydart. Continued rhododendron management across the landscape is also recommended.
9. **Consider targeted projects to reinforce certain wild tree populations.** Some wild trees had small population sizes across the survey area, including bird cherry, grey willow, wych elm, aspen, creeping willow and guelder rose. Despite this, most showed signs that they have capacity for natural recovery, with evidence of recent recruitment or suppressed seedlings found. Guelder rose was the exception, with only 2 mature plants recorded along the Sandaig Burn. A targeted project to reinforce this population could be beneficial. It is recommended that cuttings or seed be sourced from both the relict population and from larger wild populations elsewhere on Knoydart to enhance

genetic diversity. Suitable guelder rose source populations were found along the Beinn Bhuidhe ravine (NG87540361, NG87640354, NG87650353, NG87670350) and Allt Slochd Nighinn Bheathain (NG89430294, NG89690288, NG90440275) during the Wild Trees Survey of Barrisdale. Seedlings could then be planted out along the Sandaig Burn just below the Sandaig Burn fence, which is close to the relict population and has suitable soil conditions for guelder rose.

10. **Plant strategically and sensitively.** Planting projects have been undertaken widely across the survey area. These have reintroduced Scots pine to the landscape and will increase tree cover and establish additional seed sources for natural regeneration in future. The following recommendations are made for future planting projects:

- Map ecological opportunity areas and constraints across the landscape. This will allow projects to be targeted strategically towards areas where planting benefits would be greatest, while avoiding areas where negative impacts could arise. Examples of opportunity areas include relatively fertile soils and riparian areas, particularly where woodland establishment in these locations could contribute to strengthened connectivity at landscape-scale. Examples of constraints include peatlands and species-rich grasslands, black grouse lek sites, threatened planting-sensitive species (e.g. butterfly orchids, waxcap fungi), existing natural regeneration, and natural expansion zones around wild tree populations and woodland.
- Aim to minimise planting on near-deep peats (peat \geq 30 cm) and avoid mounding on peaty soils. This will help ensure planting on deep peat (\geq 50 cm) is avoided and protect significant stores of soil carbon from disturbance.

11. **Develop a monitoring program to inform ongoing management and measure recovery progress.**

The Wild Trees Survey has established a baseline for Ancient Woodland, wild and planted tree populations, vegetation, refugial species, herbivore impacts, and non-native plants across the survey area. This makes it possible to quantify future change through monitoring. When planning a monitoring program, it is helpful to consider:

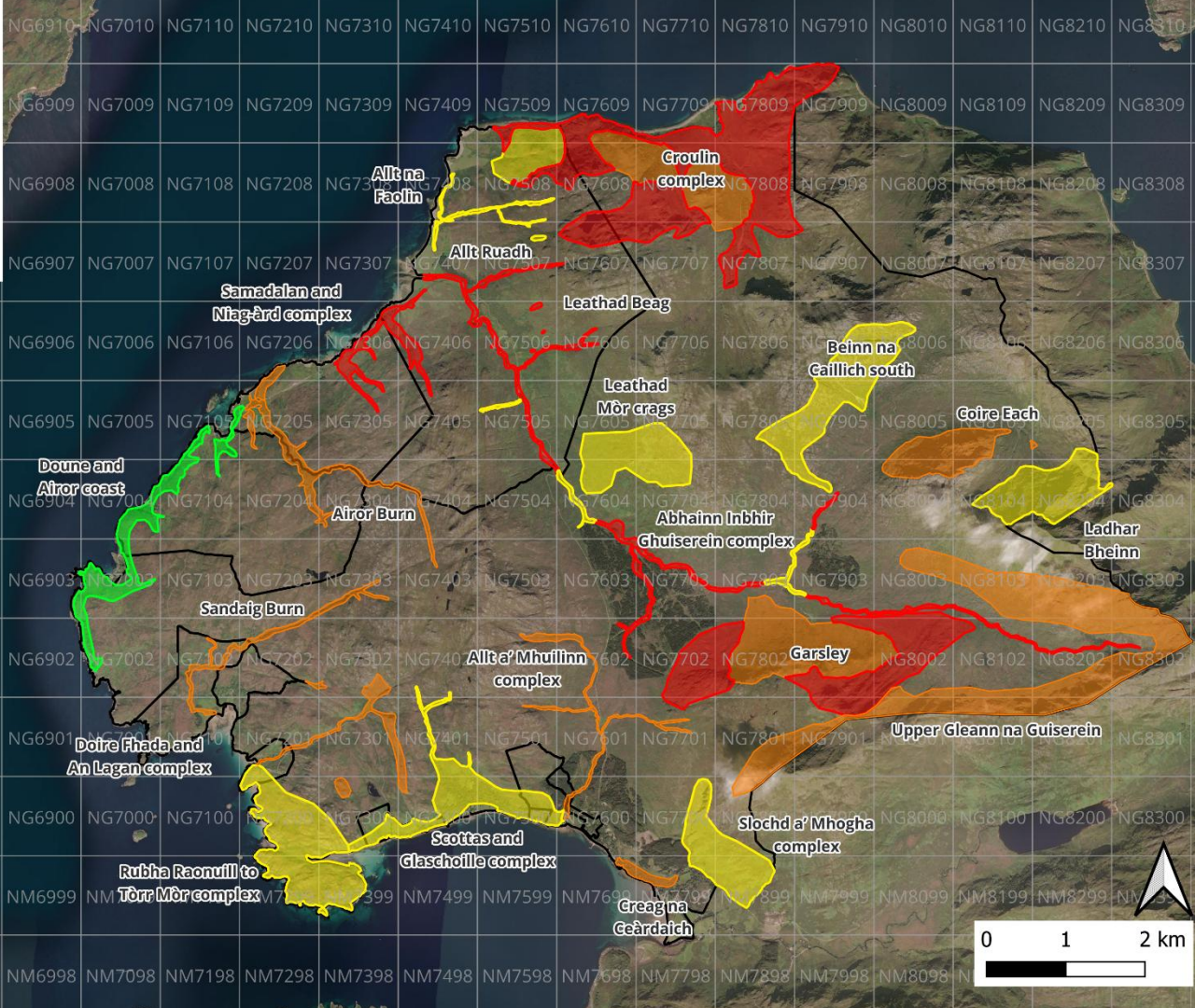
- *Drivers, outcomes, indicators and rates of change.* Key drivers of change identified through the survey include herbivore impacts and non-native plants. These can respond quickly to management interventions. Over time, herbivore impacts and non-native plants can influence outcomes for Ancient Woodland, wild and planted tree populations, vegetation, and refugial species. Examples of indicators of positive change could therefore include reductions in herbivore impacts and the distribution and abundance of non-native plants, increases in diversity and abundance of wild trees and refugial species, and increases in average palatability of vegetation.
- *Information needed for management purposes.* For example, effectively managing herbivore impacts requires information on fence condition, deer and livestock populations, and levels of herbivore impact. This can be obtained through fence checks, deer counts, stocking records and herbivore impact assessment results.
- *Appropriate monitoring methods, frequencies, periods and scales.* For example, herbivore impacts can be monitored using Woodland Herbivore Impact Assessment. Carrying this out annually across the landscape, ideally at the end of winter, can inform ongoing management. Conversely, positive indicators for wild trees, vegetation and refugial species are expected to take longer to show significant changes, so could be monitored by repeating the Wild Trees Survey every 10 years.

Based on these considerations, an example monitoring plan is presented in Appendix 5. Key aspects of this include annual monitoring of fences, deer, livestock, and herbivore impacts; responsive monitoring of non-native plants; and decennial monitoring of Ancient Woodland, wild and planted tree populations, vegetation, and refugial species.

Map 9: Priority Areas for Recovery

refuge priority level

- very high
- high
- medium
- low
- survey area



Map 10: Woodland and Natural Expansion Zones

- native woodland
- 50 and 100 m natural expansion zones around native woodland, plus indicative areas with natural regeneration in wider landscape
- refuges
- survey area

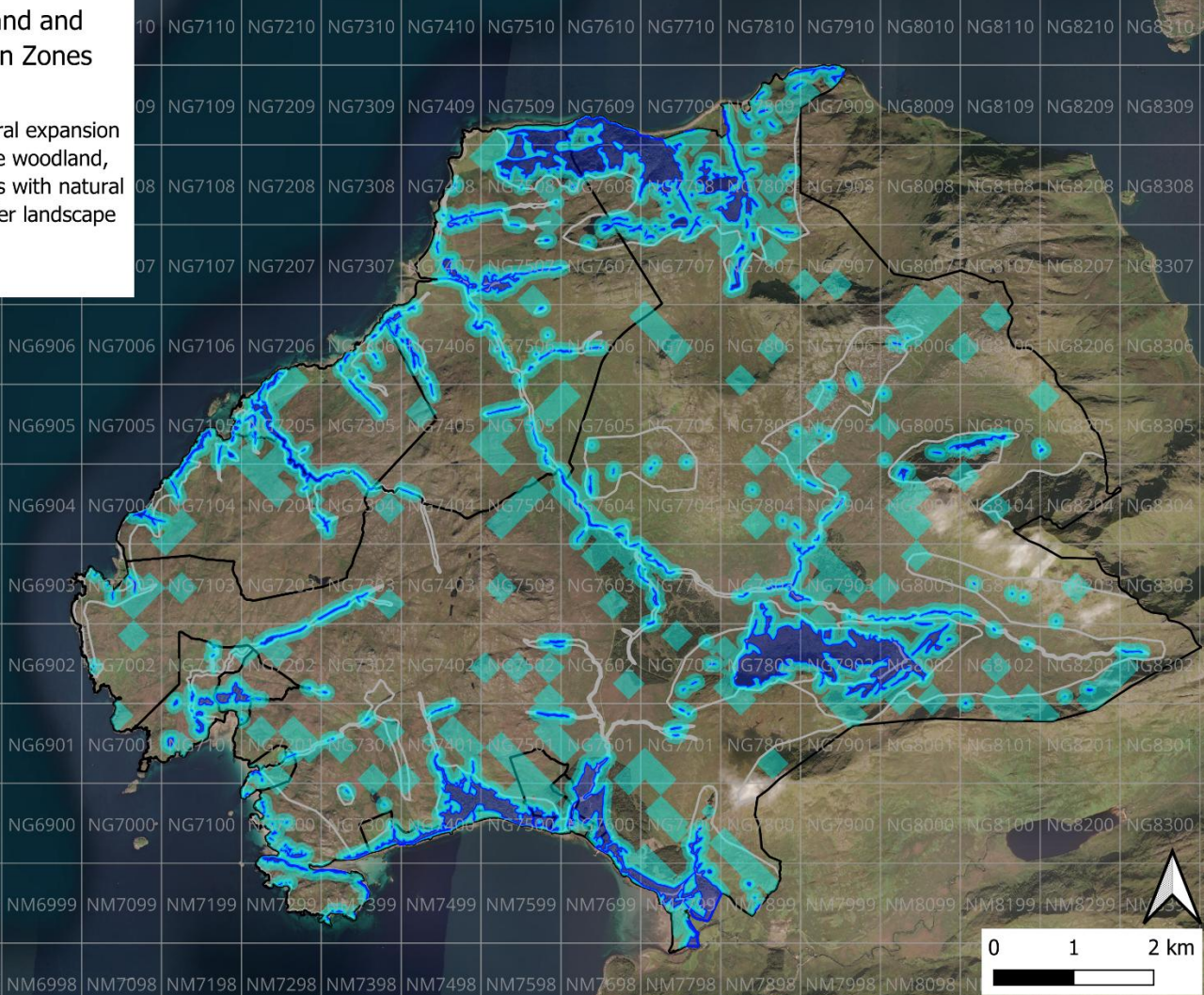


Table 2: Recommendations summarised for each refuge. Key recommendations are highlighted by ✓

Refuges colour coded by priority:	Ancient Woodland area and % deer fenced	Other native woodland area and % deer fenced	1: natural regen.	2: landscape-scale deer mgmt.	3: manage existing deer fences	4: consider new fences	5: hill sheep management	6: strategic grazing	7: remove conifer plantations	8: non-native species control	9: targeted planting	10: sensitive planting	11: monitoring
Abhainn Inbhir Ghuiserein complex	11.2 ha 42%	4.1 ha 86%	✓	✓	✓	✓	✓		✓	✓			✓
Allt Ruadh	2.1 ha 68%	0.8 ha 97%	✓	✓	✓	✓	✓			✓			✓
Croulin complex	103.8 ha 61%	26.9 ha 89%	✓	✓	✓	✓	✓	✓		✓			✓
Garsley	65.5 ha 72%	42.3 ha 100%	✓	✓	✓	✓				✓			✓
Leathad Beag	0.1 ha 0%	N/A	✓	✓		✓	✓						✓
Samadalan and Niag-àrd complex	2.3 ha 55%	3.3 ha 100%	✓	✓	✓	✓		✓		✓			✓
Airor Burn	9.2 ha 100%	3.2 ha 100%	✓		✓					✓			✓
Allt a' Mhuilinn complex	3.5 ha 90%	1.5 ha 100%	✓	✓	✓	✓				✓			✓
Coire Each	0.1 ha 0%	4.1 ha 0%	✓	✓									✓
Creag na Ceàrdaich	2.3 ha 100%	N/A	✓		✓					✓			✓
Doire Fhada and An Lagan complex	0.2 ha 100%	0.2 ha 100%	✓		✓					✓			✓
Sandaig Burn	0.9 ha 100%	2.4 ha 100%	✓		✓					✓	✓		✓
Upper Gleann na Guiserein	0.1 ha 0%	0.3 ha 0%	✓	✓						✓			✓
Allt na Faolin	1.6 ha 80%	0.4 ha 80%	✓	✓	✓		✓			✓			✓
Beinn na Caillich south	N/A	0.5 ha 0%	✓	✓			✓			✓			✓
Ladhar Bheinn	N/A	N/A	✓	✓									✓
Leathad Mòr crags	N/A	0.6 ha 74%	✓	✓			✓			✓			✓
Rubha Raonuill to Tòrr Mòr complex	5.0 ha 100%	2.1 ha 100%	✓		✓					✓			✓
Scottas and Glaschoille complex	23.7 ha 100%	19.9 ha 100%	✓		✓			✓		✓			✓
Slochd a' Mhogha complex	2.8 ha 77%	0.9 ha 70%	✓	✓	✓					✓			✓
Doune and Airor coast	3.0 ha 100%	2.9 ha 100%	✓		✓								✓
wider landscape	N/A	61.9 ha 99%	✓	✓	✓		✓	✓	✓	✓		✓	✓



Abundant natural regeneration outside deer fences around Allt Coire Torr an Asgaill. Moderate reductions in herbivore impact in this area would likely allow significant amounts of regeneration to establish.



A photo taken along a fenceline in another part of western Scotland. Outside the fence (left) woodland is dying and the vegetation is dominated by grasses, while berry-producing dwarf shrubs have regrown inside (right), and natural regeneration is taking place.



Natural recovery and expansion of Ancient Woodland without the use of fencing in Strathspey, where effective landscape-scale deer management is also helping peatlands and montane habitats recover



Restored tall herb vegetation and montane willow scrub on previously grassy slopes at Ben Lawers. Tall herbs are widespread but concentrated in inaccessible areas on Knoydart. There is potential for them to spread if impacts were reduced at landscape-scale.

5. References

1. Bacles, C. F. E., Lowe, A. J. & Ennos, R. A. (2004) Genetic effects of chronic habitat fragmentation on tree species: the case of *Sorbus aucuparia* in a deforested Scottish landscape. *Mol Ecol.* 13(3), 573- 84
2. BiodivERsA (2014) Policy brief: Adaptation of trees and forests to climate change: the importance of genetic variability
3. Fady, B., Cottrell, J., Ackzell, L., Alía, R., Muys, B., Prada, A. & González-Martínez, S. C. (2015) Forests and global change: what can genetics contribute to the major forest management and policy challenges of the twenty-first century? *Reg Environ Change*
4. Wachowiak, W., Salmela, M.J., Ennos, R.A., Iason, G. & Cavers, S. (2011) High genetic diversity at the extreme range edge: nucleotide variation at nuclear loci in Scots pine (*Pinus sylvestris* L.) in Scotland. *Heredity* 106, 775- 787
5. Gullett, P. R., Leslie, C., Mason, R., Ratcliffe, P., Sargent, I., Beck, A., Cameron, T., Cowie, N. R., Hetherington, D., MacDonell, T., Moat, T., Moore, P., Teuten, E. & Hancock, M. H. (2023) Woodland expansion in the presence of deer: 30 years of evidence from the Cairngorms Connect landscape restoration partnership. *J Appl Ecol.* 2023;60:2298-2308
6. Met Office, Brelach Na Ba station: <https://www.metoffice.gov.uk/research/climate/maps-and-data/uk-climate-averages/gf5yws93h>
7. British Geological Survey, Geology Viewer: https://geologyviewer.bgs.ac.uk/?_ga=2.225793626.1578801857.1727095467-1721843961.1727095467
8. Pont Maps of Scotland (ca. 1583-1614) Pont texts, Loch Carrown upon the west sea, Glen-morisden and the marchis of the bordering Lands. 123v-124r
9. Pennant, T. (1774) *A Tour in Scotland and Voyage to the Hebrides*, 1772
10. Roy, W. (1747-1755) *Military Survey of Scotland*, Roy Highlands map.
11. W. & A.K. Johnston Limited (1850) *Plan of the estate of Knoydart*.
12. Ordnance Survey, Six-inch 1st edition maps, Scotland (1843-1882)
13. Rainey, J. (2024) *Wild Trees at Barrisdale: Wild Trees Survey findings*. Trees for Life.
14. Forestry Commission (1994) *Caledonian Pinewood Inventory*. Forestry Commission, Edinburgh
15. Sayers, J. M. and Rainey, J. (2025) *Wild Pine at Slios Garbh: Wild Pine project findings*. Trees for Life.
16. Brown, J. (2025) *pers comms*.
17. Rainey, J. and Holmes, F. (2023) *Caledonian Pinewoods: Findings from the Caledonian Pinewood Recovery Project*. Trees for Life
18. Armstrong, H., Black, B., Holl, K. & Thompson, R. (2023) *The Woodland Herbivore Impact Assessment Method User Guide*
19. Rainey, J., Williamson, N., Kiel, S. and McDonnell, A. (2022) *Opportunities and priorities for ecological restoration at Lochhourhead*. Trees for Life and Affric Highlands.
20. Rainey, J. (*in prep.*) *Li and Coire Dhorrcail: Wild Trees Survey findings*. Trees for Life.



Woodland inside the Allt Ruadh ravine, one of the best diversity hotspots found during the survey

