

Workshop report: 'Growing together': research-practice partnership for woodland restoration'

On 9 June 2026, the Edinburgh University Centre for Sustainable Forests and Landscapes (CSFL), in collaboration with Forest Research, Woodland Trust, and Future Woodlands Scotland hosted a workshop titled 'Growing together: research-practice partnership for woodland restoration' in the Edinburgh Climate Change Institute.

Recent work by CSFL highlighted the diverse knowledge needs of practitioners in Scotland and the importance of deeper research–practice collaboration ([Daniels-Creasey et al., 2025](#)). Addressing these needs requires opportunities to build relationships, share knowledge, and co-design and co-produce research. The aim of this all-day event was therefore to bring together woodland restoration practitioners and researchers with the aim to strengthen collaboration and knowledge exchange.

During the morning, there was a short talk which framed practitioner knowledge needs and Forest Research responded with their relevant expertise in woodland restoration. The afternoon focussed on action-learning sessions with small-group discussions to explore: (1) established knowledge and understanding; (2) current learning, trialling, researching; and (3) future learning ideas, gaps, critical questions.

The day proved popular, with 65 registrations split equally between research and practice. There was a broad cross-section of Scotland's forest, peatland, and nature restoration community, spanning senior scientists and research managers from Forest Research and universities (Edinburgh, Stirling, UHI, RBGE), policy and regulatory leaders from Scottish Forestry and NatureScot, and conservation NGOs including the Woodland Trust, Plantlife, the Scottish Wildlife Trust, Cairngorms Connect, the National Trust for Scotland, and Countryside Trusts (Argyll, Fife, and Loch Lomond & The Trossachs). Industry and professional forestry were represented by Scottish Woodlands Ltd, RTS Forestry, the Native Woods Cooperative, Confor, consultants, and estate and landscape managers from Ardtornish, Brambletree, and Woodland Trust estates.

Conversations flowed freely on the day and feedback during the event and in the feedback-survey confirm there is much appetite for more frequent research-practice partnership events

Report structure:

1. Workshop programme, including access to the slides
2. Synthesis of the thematic discussions
3. Evaluation and suggestions for future research-practice partnership activities
4. Appendix with detailed notes from the thematic discussions

Credits:

- Event host and funder: CSFL
- Organising committee: Marc Metzger (CSFL), Alastair Seaman (Woodland Trust), Ailsa Watson (Future Woodlands Scotland)
- Speakers: Bianca Ambrose-Oji; Kevin Watts; Alice Broome; Katty Baird; Alice Broome; Joan Cottrell; Cally Ham; Ainoa Pravia; Darren Moseley
- Facilitators: Ian Dow (Argyll Countryside Trust), Henry Dobson (Ardtornish Estate); James Rainey (Trees for Life); Mike Daniels (UHI)
- Note takers: Mareike Feldmann (CSFL), Rachel Orchard (CSFL), Ailsa Watson (Future Woodlands Scotland), Marc Metzger (CSFL)

1. Workshop programme

Aims of the day: To bring together woodland restoration professionals with researchers to strengthen collaboration and knowledge exchange. Specifically, the day:

- Provided insight into Forest Research's new science innovation strategy and their relevant research and expertise related to woodland restoration
- Showcased practitioner expertise and knowledge needs
- Facilitated knowledge exchange between practitioners and researchers through discussion around questions and challenges experienced in restoration case-studies.
- Reflected how collaboration between researchers and practitioners can be supported and encouraged.

Audience: approximately 60 woodland restoration experts from research and practice.

Programme:

9.30	Welcome and aims of the day (Marc Metzger)
9.40	Practitioner knowledge needs (Ailsa Watson & Alastair Seaman)
10.05	Woodland restoration research at Forest Research (Bianca Ambrose-Oji)
10.30	Coffee break
11.00	Overview of FR expertise (chaired by David Edwards) • Native woodland establishment - Kevin Watts • Woodland management for nature recovery - Katty Baird & Alice Broome • Genetic diversity and adaptation - Joan Cottrell • Monitoring impacts of mammals - Cally Ham • Soil ecology - Ainoa Pravia • Mycorrhizal research – Darren Moseley
12.30	Lunch
13.15	4x 30 minutes carousel of case-study discussions (Mike Daniels, Ian Dow, James Rainey & Henry Dobson)
15.30	Coffee break
15.45	Report back 4x 5min
16.05	Reflection - how collaboration between researchers and practitioners can be supported and encouraged? (Marc Metzger)
16.30	Closure

The slides of the morning's presentations can be accessed [here](#).

2. Synthesis of the thematic discussions

The afternoon was mostly spent discussing four themes that were identified in the earlier research as having substantial practitioner knowledge needs. Discussion took place in smaller groups, following a carousel approach. Workshop participants were split in four groups that circulated between topics, spending 30 minutes discussing each theme. The themes were introduced by experts who also facilitated the discussion.

Below we provide a synthesis of the discussion notes, with the original more detailed notes from the note takers in Appendix 1.

Deer management

Expert facilitator: Mike Daniels, UHI

Note taker: Marc Metzger, The University of Edinburgh

Established knowledge and understanding

- Deer management too often relies on opinion and perception rather than scientific understanding, partly due to inconsistent data, limited knowledge sharing, and cultural/political factors.
- Quantifying economic and ecological damage from deer remains challenging, hampering clear messaging on urgency.
- Red deer ecology is relatively well understood; population dynamics of roe deer and especially sika deer are less so. Sika are elusive, hard to control, and likely under-estimated ([Brown et al., 2025](#)).
- Venison markets could incentivise population control but face regulatory and cultural barriers, with risks of entrenching high populations if wild venison becomes a commodity.
- Public support for deer population management (culling) exists ([Hare et al., 2021](#)), but effective education and communication are still challenging amid vocal minority interests.

Current learning, trialling, researching

- Disparate trialling underway on:
 - Tree protection methods (e.g., Trico, degradable tubes)
 - New technologies for monitoring deer (UAVs, camera traps, etc.)
 - Projects to encourage wild venison consumption
- [NatureScot has developed an updated deer population model.](#)
- Advances in vegetation and carbon modelling (e.g., at the University of Edinburgh).
- Forest Research deer research was cut in the 2010s (framed as an implementation gap rather than a research gap) but has restarted.
- Forest Research and University of Stirling are monitoring woodland establishment (planting to natural colonisation) under varying intervention levels (including exclosures).

Future learning ideas, gaps, critical questions

- Efficacy and cost–benefit of tree protection methods:
 - Tubes, fencing, deterrents (olfactory such as Trico; sound; lights), deer dogs, UAVs, immunocontraception, lynx reintroduction, etc.
- Quantifying ecological and socio-economic damage:

- New technologies (UAVs, eDNA) and interoperable herbivore impact assessments ([new report](#) on this subject for open habitats just published)
 - Economic cost of culling vs fencing vs tolerating high densities
 - Societal costs of deer–vehicle collisions and Lyme disease at high densities
 - Deer welfare (low carcass weights, high winter mortality)
- Robust population estimates and models:
 - Standardised methods for context-specific management
 - Models that account for dispersal and are usable in diverse contexts
 - New tech inputs (camera traps, UAVs, acoustic monitoring)
 - Sika behaviour, impacts, and dynamics
- Opportunities and challenges of leaving carcasses on the hill:
 - Ecological benefits, societal resistance
- Opportunities and risks in venison markets:
 - Economics, community deer management, public attitudes, administrative barriers
- There is a need for a central resource for deer research and knowledge exchange (e.g., resurrect <https://deerscotland.info/about.php> open in new).

Native Pinewoods

Facilitator: James Rainey, Trees for Life

Note taker: Ailsa Watson, Future Woodlands Scotland

Established knowledge and understanding

- Distribution and extent:
 - First mapped in the 1950s (Steven & Carlisle); Caledonian Pinewood Inventory (CPI) in the 1990s listed 84 sites.
 - Wild Pine project suggests 100–110 sites including additional (unrecognised) areas; wider resource mapped by NWSS.
- Regional differences:
 - Caledonian pinewoods span boreal (east) and temperate rainforest (west) systems; marked east–west differences in soils and biodiversity.
 - Western pinewoods more fragmented and challenged; selective browsing of Scots pine seedlings noted in SW, favouring birch dominance; growth slowdown in western mature pines over the past decade suggested by dendro evidence.
- Genetics and adaptation:
 - Multiple wild pine origins in Scotland; high gene flow via wind-pollination; regional phenotypic differences evident; traits often polygenic.
- Biodiversity:
 - Rich old-growth features; broader diversity suppressed by herbivory.
 - Known hotspots (e.g., steep ravines); key species/groups include lichens, twinflower, one-flowered wintergreen, capercaillie, pine hoverfly.
- Regeneration and mobility:
 - Continuous natural regeneration is defining and essential for resilience and climate adaptation; main barrier is herbivore impact.
 - Scarification, burning, and grazing have been trialled; high-density uniform regen is not always ecologically desirable.
- Cultural and historical values:
 - Early pine declines (3–5k BP) often attributed to climate; later declines linked to felling/burning/grazing.

- New stump-field evidence outside peat (15th–16th century) suggests substantial anthropogenic roles in more recent declines.
- Threats and management:
 - Herbivore impacts are primary barrier; fencing alone often insufficient in west due to slow establishment relative to fence lifespan.
 - Non-native species (notably on public estate), including rhododendron and Gaultheria, and proximity to commercial forestry complicate recovery.
 - Pests/pathogens of concern include Dothistroma (esp. lodgepole–Scots pine strain interactions) and Hylobius; Curreya pithyophila likely long present and minor.
- Strategic context:
 - Long-term, landscape-scale management needed; site prioritisation underway; Wild Pine sites need recognition (e.g., within CPI).
 - Ancient woodland context and historical mapping (1st OS) are key for planning.

Current learning, trialling, researching

- Wild Pine project: mapping, historical/dendro work, and genetic sampling with CEH; evidence of widespread relic stumps and fir-candle marks.
- Dendrochronology (Rob Wilson): climate-growth signals; indications of western growth slowdown.
- Site-based programmes: Abernethy (RSPB), Black Wood of Rannoch (FR); monitoring by NatureScot and Cairngorms Connect; local biodiversity restoration (Plantlife twinflower, RZSS pine hoverfly).
- Population genetics: CEH and FR, including whole-genome sequencing (Stephen Cavers).
- Management research: Costs, benefits, and trade-offs of fencing vs alternatives (Mike Daniels et al.); Common Ground Forum discussions.
- Pests and pathogens: FR silviculture for tree health; Univ. of Hertfordshire mycovirus work for Dothistroma; FLS trials to manage Hylobius via lifecycle-aware operations.
- Climate adaptation: Provenance trials in dry east of England as a proxy for future Highland conditions.
- Strategic processes: CPI/site prioritisation through the Caledonian Pinewood Partnership; anticipated review of SF grant schemes.

Future learning ideas, gaps, critical questions

- Regional dynamics and herbivory:
 - Causes and seasonality of selective browsing on Scots pine in SW; thresholds for deer density in west; multiple-herbivore interactions and knock-on effects on invertebrates/fungi.
- Biodiversity and monitoring:
 - Map biodiversity hotspots at scale and integrate into policy; standardised pinewood monitoring to compare sites and management approaches.
 - Investigate kelo-tree biodiversity and relevance to Scotland.
- Regeneration and seed ecology:
 - Publish seed viability trials across populations and years; evidence review of natural regeneration/expansion (vs planting) to refine guidance; assess which associated species lag behind pine mobility and when translocations are warranted.
- History and culture:
 - Holocene review of pine declines disentangling climate vs exploitation; wider dendro of stump-fields to time felling; research on fir-candle heritage for public engagement.
- Non-native species and commercial forestry:
 - Synthesis of impacts (harbouring deer, pine weevil irruptions, Dothistroma risks) to inform zoning, buffers, and felling practices around CP and Wild Pine sites.
- Climate change resilience:

- Monitor climate impacts; identify microrefugia and microsites (e.g., slopes/knolls) especially in the west; assess adaptive potential via natural regen and genetic variation.
- Pests and pathogens:
 - Reassess zoning/buffer adequacy (include Wild Pine sites); determine *Hylobius* impacts on CP outside plantations; monitor emerging global threats to Scots pine; clarify *Curreya* significance.
- Strategy and incentives:
 - Develop a strategic guide for pinewood restoration (priorities: protect/restoring ancient sites, connect fragments, then improve plantations).
 - Align grants to reward natural regeneration and landscape outcomes; balance urgent fencing needs with transition to landscape-scale management.

Invasive Non-Native Species (INNS)

Facilitator: Ian Dow, Argyll Countryside Trust

Note taker: Mareike Feldmann, The University of Edinburgh

Established knowledge and understanding

- Quantification historically via ground surveys; increasing drone use.
- *Rhododendron ponticum* is a primary focus; clearance efforts began 30–40 years ago, typically cutting and burning, plus herbicide use (e.g., glyphosate).
- Ecological legacy after clearance:
 - Multi-decadal pause in revegetation; high reinvasion risk.
 - Altered soils (e.g., higher water-holding capacity; potential anaerobiosis).
 - Local extinctions of vascular plants, bryophytes, fungi.
 - Long-assumed allelopathy increasingly reframed as mycorrhizal shifts constraining recolonisation.
 - Leaf litter accumulation impedes recovery.

Current learning, trialling, researching

- Quantification:
 - Drone and ground surveys; movement toward LiDAR integration and machine learning.
- Clearance methodologies:
 - Refinement toward less harmful approaches (e.g., stem injection vs broadcast spraying; mulching vs burning).
 - Thermo-electric control demonstrated for herbaceous INNS; exploring suitability for woody plants.
- Ecological processes and restoration:
 - eDNA comparisons across uninvaded, invaded, and cleared sites (1–30 years post-clearance).
 - *Rhododendron* litter decomposition shown to depend on saprophytic fungi.
 - Trials/ideas around BioChar (including *rhododendron*-derived) with soil decompression; attention to ericoid fungi and mycorrhizal dynamics.

Future learning ideas, gaps, critical questions

- Quantification and confidence:
 - Validate accuracy differences between drone, LiDAR, and ground methods; build practitioner confidence in remote surveys.
 - Non-chemical control and prevention:
 - Prepare for potential glyphosate restrictions; test thermo-electric methods for woody invaders; assess feasible biocontrol/natural enemies.
 - Frameworks to prioritise sites for clearance and to predict/prevent likely invasions.
 - Assess feasibility/contexts for “one-and-done” clearance given policy/legislative trends; capitalise on generational shifts among private landowners.
 - Ecological recovery:
 - Does rhododendron Biochar aid nutrient availability? Is it too acidic alone—what mixes/rates are effective?
 - How to accelerate litter breakdown (e.g., fostering saprophytic fungi)?
 - Role of deer browsing in post-clearance revegetation success/failure.
 - Engagement and incentives:
 - Effective narratives (e.g., “beauty or the beast?”) for public/political support.
 - Economic incentives for estates/companies to undertake long-term management and aftercare.
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Conservation grazing

Facilitator: Henry Dobson, Ardtornish Estate

Note taker: Rachel Orchard, The University of Edinburgh

Established knowledge and understanding (based on experience at Ardtornish Estate)

- Objectives-led approach:
 - Shift from species-specific to ecosystem/habitat outcomes; flexible habitat definitions support holistic, landscape-scale management.
- Practical context:
 - At Ardtornish (12k ha, rainforest initially in unfavourable condition due to over-browsing), previous reliance on fencing led to under-grazing within fences.
 - Three zoned approaches:
 - Regenerative grazing on improved ground (food production; agroforestry/wood pasture elements).
 - Protect & restore areas using conservation grazing (cattle/ponies) to trample bracken/Molinia, create windows for tree regen and ground flora recovery.
 - Self-willed land with free-ranging livestock in a culturally connected transhumance model to promote heterogeneity.
- Engagement:
 - Conservation grazing can effectively engage farmers, but risks polarisation between conservation and commercial framings.
 - Many conservation grazing projects are hard to sustain long-term.
- Context with wild herbivores:
 - Since 2018: reduced deer densities and removal of sheep from the hill; need to integrate livestock and deer management.

Current learning, trialling, researching

- Species-specific roles:
 - Ponies more effective than expected for certain tasks; sheep better on pasture; goats for scrub; cattle/bison woodland impacts context-dependent (numbers, breed).
- Tools and logistics:
 - Virtual fencing/cattle collars expanding feasible grazing patterns.
 - “Flying flocks” vs permanent herds matched to objectives and landholding realities.
- Habitat focus and transferability:
 - Rainforest as a testbed for woodland grazing approaches; potential to transfer lessons to other woodlands, including commercial contexts.
- Multiple herbivory:
 - Active exploration of interactions between deer and domestic grazers; linking with landscape-scale deer management.

Future learning ideas, gaps, critical questions

- Evidence base and case studies:
 - Impacts of cattle across habitats (soil carbon, fire risk, topography interactions), including breed/stocking nuances.
- Monitoring and decision support:
 - Practical tools for managers to monitor outcomes and adaptively manage; formalise tacit expertise and grey literature into accessible guidance.
- Social dimensions:
 - Practitioners’ motivations, risks, opportunities; public perceptions of livestock grazing and deer control; neighbouring landowners’ attitudes to landscape-scale approaches; views of traditional farming workers.
- Economics:
 - Robust economic analyses to underpin anecdotal benefits and enable implementation at scale.
- Applicability:
 - Where and how to apply conservation grazing in commercial woodlands and rainforests.
- Defining success:
 - Clear, measurable success criteria for grazing in woodlands across biodiversity, structure, regeneration, and cultural outcomes.

3. Evaluation and suggestions for future research-practice partnership activities

Overall sentiment during the event and in the feedback survey was very positive, with strong appetite for more research–practice events. Participants most valued the balanced, practice-focused format and the mix of people in the room. Short, relevant morning presentations followed by topical breakout carousels kept the day engaging, while strong participation from both practitioners and researchers gave discussions depth and credibility. Well-run facilitation, ample networking time, a manageable group size, and an accessible venue all contributed to productive conversations and useful new connections.

—Excellent balance of research and practitioner input and attendance. Stimulated discussions and connections in the breaks that will positively feed into my own research.

—Good mix of practitioners and a range of researchers with relevant work to share... The roundtables in the afternoon were very well facilitated and did lead to some interesting discussions.

—The presentations and activities were highly relevant. The structure of the workshop was well designed to keep the audience engaged.

There were suggestions for improvement centred on clarity, pacing, and consistency. Participants asked for a clearer statement of aims, hoped-for impact, and concrete next steps, with tighter framing toward specific outputs. Slightly fewer or shorter plenary talks would create more discussion time, and the afternoon carousel felt intense. More consistent, slightly firmer chairing would help balance voices and keep sessions focused, and several people requested more practitioner-led case studies with “lessons learned,” earlier circulation of the agenda, and an attendee list with contacts and one-line bios.

—Not sure - maybe more elective workshop sessions where people could hone in on topics of particular interest? But I also liked the fast pace of the day.

—Slightly stricter chairing would also have helped keep the discussion focused.

—[improve] Clarity around purpose / next steps / hoped for impact

There was strong appetite for regular follow-ups: most respondents to the survey favoured an annual in-person event, with several proposing twice-yearly, complemented by short online thematic sessions between gatherings. Participants suggested formats such as researcher–practitioner paired talks on specific topics, light-touch poster/update marketplaces, elective breakout tracks, and field visits to see restoration in practice, alongside themes on community engagement and creative approaches to woodland/rainforest governance. Future events should coordinate with existing networks (e.g., the Alliance for Scotland’s Rainforest) to avoid duplication and improve access through better advertising.

— I wonder if these could be supplemented by online events around particular themes - with both a researcher and practitioner leading / presenting and time for follow up discussion?

—Site visits for Research to see in practice what is happening on the ground?

—Workshops and open discussions on community engagement and creative approaches to forestry management and governance

4. Appendix with detailed notes from the thematic discussions

The detailed notes from the four thematic discussions were captured in slightly different formats, but capture greater detail than the synthesis in section 3.

Deer management

Expert facilitator: Mike Daniels, UHI

Note taker: Marc Metzger, The University of Edinburgh

Group no.	Recently learnt	Current learning, trialling, researching	Future learning ideas, gaps, critical q's
Synthesis	Deer management too often relies on opinion and perception and too little on scientific understanding. This is part due to a lack of consistent data and knowledge sharing, but also cultural perceptions and politics. Promising new tree protection methods are trialled (e.g. trico, degradable tubes), but learning is not effectively shared, and cost/benefits remain unclear. Quantifying economic and ecological damage from deer remains challenging, hampering messaging about urgency. While red deer ecology is well understood, population dynamics of roe and especially sika deer less so. Sika are elusive, hard to control, and numbers under-estimated (Brown et al., 2025). Venison markets could provide an incentive for population control, but there are major barriers (regulatory, cultural) and also risks of maintaining	There is a lot of (disparate) trialling including: • different tree protection methods • new technology for monitoring deer populations (UAV, camera traps, ...) • projects to encourage wild venison consumption NatureScot has developed an updated deer population model There are advances in vegetation and carbon modelling (at UoE among others) Forest Research deer research was cut in the 2010s, as deer management was seen as an implementation gap, not a research gap Forest Research and University of Stirling are actively monitoring woodland establishment (from planting to natural colonisation) under different levels of intervention (including enclosures)	Understanding the efficacy and cost / benefits of different tree protection methods • tubes; fencing; deterrents (smell (e.g. trico); sound; lights; deer dogs; UAVs; immunocontraception; lynx introduction; ...) Quantifying ecological and socio-economic damage • new technology (UAVs, eDNA, ...) and interoperability of herbivore impact assessment methods • the economic cost of culling vs fencing vs high numbers • the societal cost of deer collisions and Lyme disease from high deer density • deer welfare, including low carcass weight and high winter mortality) Robust population estimates and models • standardised methods to inform (context specific) management • population models that account for dispersal and are useable in diverse contexts

	high populations if wild venison becomes a commodity. There is evidence of public support and understanding of the need to manage deer populations (Hare et al., 2021) but effective education and communication remains a challenge, also considering vocal voices representing small interest groups.		• new technology (camera trap data; UAVs; acoustic monitoring) • Sika deer behaviour, impacts, and population dynamics Understanding opportunities of leaving carcasses on the hill • Challenges and opportunities, incl. ecological benefits, societal resistance, Understanding the opportunities of venison markets • Challenges and opportunities, incl. economics, community deer management, public attitudes, administrative barriers, Need for a central resource for deer research – perhaps resurrect this: https://deerscotland.info/about.php
Group 1	• Venison on NHS hospital and school menus in England • Venison supply chain research at FR • Deer population control social science at FR • Sika deer underestimated and hard to control (HR) • Incompatibility of upland and woodland herbivore impact assessment methods • Public access impacts on deer stalking success and ability to meet cull numbers	• Tree protections through alternative tree tubes and overplanting (D&G Woodlands) • NatureScot has developed an updated deer population model https://chrissuthy.shinyapps.io/CullPlanner/ • Vegetation modelling	• ‘mythology’ based on opinion needs to be replaced by science informed management • Community managed deer control, including larders • Sika deer population dynamics and control... need for population modelling incl. dispersion • Joined-up / interoperable herbivore impact assessment methods (upland/woodland) • Linking deer pressure to vegetation / carbon modelling • How many deer are too many in different contexts – what is the right balance • What are the barriers to wild venison markets? • The economics / cost savings of culling vs fencing vs high numbers

			• Landscape of fear approaches: sounds (also on drones) • Shoot and drop / carcasses on the hill: pros and cons, ecological benefits, societal resistance, health risks, • Education, culture change through young people to affect change in estate management
Group 2		• Carbon modelling • Peatland ecology • Browsing density challenges • FR deer research was cut in the 2010s, it is seen as an implementation gap, not a research gap • Woodland creation experiments (incl exclosures)	• Understanding the numbers, using standardised methods, and how to use this to inform (context specific) management • More consistent understanding of impacts through new technology (drones, eDNA, ...) • Social research to influence behaviours • Deterrents: scent, dogs, ... • Browsing levels, how much is too much, how little is not enough • Venison markets, community markets, making regulation work • Likely impacts of lynx on deer... how far will it get? What level of benefit will it provide? • Social science: how to frame deer damage / cost ... collisions, Lyme disease • Robust habitat impact assessment method that can be used by all
Group 3	• Public acceptance of deer control among WT members quite high, using this insight to inform WT leaders • Trialling with venison in schools, foodbanks and NHS • English grants for deer control, interested in results • DNA analysis of stomach content to understand what deer eat when • Venison markets		• What are the barriers and pitfalls of wild venison markets? • Lowland deer control: roe deer numbers, management • Deer welfare... (lower carcass weight, winter mortality)... can this influence public perception? • Governance / politics of differing opinion (small vocal against vs large support)

	• Deer health, carcass weight low, winter mortality • Fair Feast Pitlochry very successful at promoting venison • Inverness lynx reintroduction survey: 70% for, but vocal minority against		
Group 4	• Bruce Taylor (Brambletree) ran successful deer reduction incentive scheme with Affric Highland through DMG • Venison is by product and should not become the main driver!	• Why is there such a large implementation gap?	• How to influence / change embedded cultures? • Deer in urban areas... what is the damage and how to control? • Welfare impact assessment to inform population numbers • Sika deer poorly understood • Leaving carcasses on the hill, ecological advantage and social challenges • Take into account the true cost of fencing, life span reduced to max 20 years so need two rounds of fencing for a plantation + tree tubes + removal etc...

Native Pinewoods

Facilitator: James Rainey, Trees for Life

Note taker: Ailsa Watson, Future Woodlands Scotland

James' intro (to all 4 groups)

- Past research:
 - o 1959 - *The Native Pinewoods of Scotland* by Henry Marshall Steven and Alan Carlisle
 - o 1970s - Bunce long-term monitoring plots – recently resurveyed, how they've changed over 50 years – overall a densification, possibly related to fencing
 - o 1990s remapped by Forestry commission - Caledonian Pinewood Inventory - biochemical properties of pine – dividing our pinewoods into 7 biochemical regions
 - o Pine decline 3-5,000 years ago - paleoecology of pinewoods where pine stumps buried in peat
 - o Caledonian Pinewood Recovery Project findings: Surveyed 71 of the 84 sites (to varying degrees, dependent on ownership). 34% critically threatened (23% overall). SW Highlands most threatened group of sites. Deer main barrier to recovery. Privacy issues with dataset, data can be aggregated but not to identify individual sites.
- Current research:
 - o Wild Pine project – most sites only have a handful of relic pine but lots of stumps. Rob Wilson – St Andrews analysed stumps from 1400-1500s
 - o Site specific pinewood research – Abernethy (RSPB), Blackwood of Rannoch (FR)
 - o CEH – Stephen Cavers – genetics
 - o NatureScot – site condition monitoring - showing patterns of condition of pinewoods over time
 - o Robert Wilson's dendrochronology for climate reconstructions
- Main threats
 - o Levels of herbivore impact, mainly from deer
 - o INNS key threat on public sector estates (legacy of afforestation with non-native species)
 - o Climate change highlights need for resilience
 - o Prioritisation of planting over natural regeneration and expansion – focuses effort and resource towards less ecologically important areas/projects and is not creating like for like.

Topic/Issue	Current learning, trialling, researching	Future learning ideas, gaps, critical q's
Distribution and extent	• Caledonian Pinewood first mapped in 'The Native Pinewoods of Scotland' by Steven & Carlisle (1950s). • Forestry Commission updated via Caledonian Pinewood Inventory (CPI) in 1990s – 84 sites. • Wild Pine project mapping and researching additional areas. Now estimate 100-110 sites. • Wider pinewood resource (inc. pine plantations) mapped through Native Woodland Survey Scotland.	• Completion of Wild Pine project. • Suggestion that wild pine may have survived on some raised bogs in central belt, or elsewhere in Britain (eg. William Cleugh pines, Welch Marches (Sassoon <i>et al.</i>)) – further historical/palaeo/dendro/genetic work could help confirm/disprove. • Which plantation origin sites are most important for pinewood biodiversity?
Regional differences	• Caledonian Pinewoods span 2 ecosystems – boreal forest in the east, and temperate rainforest in the west. Differences in pinewood biodiversity between the 2 (partly due to climate, partly due to greater historical fragmentation of western sites). Around half of Caledonian Pinewoods occur within ASR rainforest zone. Soils vary east to west – more peat and leaching in west versus east. • Caledonian Pinewood Inventory divides sites into 7 biochemical zones (north, northwest, north central, south west, south central, northeast, east central). • CPR project found western pinewoods face greater challenges, and the SW pinewoods were most threatened group: - Initially slower growth rate for regen in west (appears to impact first 20-30 years of growth) means establishment often does not occur within lifespan of fence. Much regen lost as a result. - Selective browsing of pine regen by deer favouring birch dominance in SW pinewoods – unclear why pine is being selectively browsed in this region. - Lack of landscape-scale deer management and greater historical fragmentation in west compound challenges. - 34% of Caledonian Pinewood in SW considered critically threatened vs 23% overall. • Prof Rob Wilson showed preliminary findings from dendro work at pinewood conference: growth of mature/old pines appears to be slowing down in west over past decade vs more normal growth in east. Suggests western pinewoods struggling more with climate change.	• Continuation and expansion of dendro work: - Is growth slowdown in western pine being sustained? - Which trees are most impacted? (relate to age and tree microsite – ie. are trees growing on drier substrate less impacted, as would be expected if mechanism is increased waterlogging). Link from here to 'Threats: climate change' topic/issue. • Biodiversity of pine rainforests less well understood than biodiversity of boreal pinewoods. At least one lichen may be endemic to pine rainforests of Scotland and Norway (see <i>Melaspilea lentiginosula</i>, a species of oceanic pine forests, new to Fennoscandia), reported recently in 2017. Is there more undiscovered biodiversity in pine rainforests out there? Link here to 'Pinewood biodiversity' topic/issue. • Selective browsing on Scots pine regen in SW – further research on impact and causes would be helpful. Eg. if this is caused mainly by winter browsing, then this may influence deer mgmt. interventions required. Link here to 'Mgmt: herbivore impacts' topic/issue.

Pine genetics	• Analysis of mitochondrial and chloroplast DNA suggest multiple origins of wild pine in Scotland (Sinclair <i>et al.</i> 1998, Provan <i>et al.</i> 1998). • Scots pine populations generally genetically healthy as gene flow can take place between seemingly separate populations through long-distance pollen dispersal by wind. Evidence from an 'isolated' population in Spain showed significant outcrossing with distant populations, although most crossing was within the population. • Despite gene flow, common garden experiments show regional differences in phenotypic traits (e.g. height, budburst) for pine in Scotland (see Beaton <i>et al.</i> 2022). Many individual traits are controlled by multiple genes. • CEH and FR currently researching pine population genetics. Stephen Cavers starting whole genome sequencing.	• Role of epigenetics in pine adaptation and differences in traits between regions? • Continuing population genetic work – can this be used to identify wild pine populations? Wild Pine project has been collecting leaf samples from sites and sharing with CEH.
Pinewood biodiversity	• Good summaries of pinewood biodiversity in 'Abernethy Forest: The History and Ecology of an Old Scottish Pinewood' (Ron Summers); Managing the pinewoods of Scotland (Mason <i>et al.</i>); Appendix 1 of CPR project report. • CPR project found Caledonian Pinewoods remain important for old growth features, but wider diversity suppressed by levels of herbivore impact. • Wild Pine project has identified diversity hotspots in landscape, particularly steep-sided ravines. • Rare plants: twinflower, one-flowered wintergreen. Plantlife leading partnership in Cairngorms to restore these species. Site mgmt. trials, cultivation and translocations undertaken. North Highland Twinflower Project working on twinflower cultivation and translocations outside Cairngorms. Trees for Life have also undertaken twinflower cultivation and translocations. • Rare inverts: RZSS have led pine hoverfly work in Cairngorms. Site mgmt., ex situ populations, reintroductions. • Capercaillie: RSPB, Cairngorms Connect, CNP. Diversionary feeding of predators, site mgmt., disturbance mgmt. etc.	• Understanding distribution of biodiversity hotspots is important for how we approach ecological recovery work – build outwards from hotspots, ensure management allows not just expansion of tree cover but expansion of whole ecosystem. How do we integrate what we already know about hotspots into policy? Can hotspots be mapped across Highlands? Link from here to 'Strategic' topic/issue. • Investigate biodiversity of kelo trees in Scotland – link with Finnish Kelo project? • Continue building understanding of key species/groups and their needs. • Development of standardised monitoring approaches for pinewoods? Would allow comparisons to be made more easily across different sites and for different mgmt. approaches.

	• Kelo project: Finland-based project for understanding dynamics and role of kelo trees (standing dead Scots pine) in boreal forest. Not currently working in Scotland. • Monitoring of pinewood biodiversity: Cairngorms connect, site-based (eg. Mar Lodge, Abernethy, Wildland). • Lichens: 'The lichens of the Scottish native pinewoods' by Coppins & Coppins.	
Regeneration and mobility	• CPR project: regeneration critical for health and resilience of Caledonian Pinewood – needed to replenish diversity features important for pinewood health, and needed to allow adaptation and recovery after disturbance important for pinewood resilience. Mobility also crucial so pinewoods can adapt to climate change. • Main barrier to regeneration is herbivore impacts, see 'Threats and mgmt.: herbivore impacts'. • Scarification, burning and grazing have also been trailed before to initiate/increase density of natural regeneration. However, uniform high density natural regeneration may not be desirable ecologically. • Observations from growing pine in nurseries suggests seed viability may be higher for eastern pine. • Because continuity of natural regeneration is a defining quality of Caledonian Pinewood, nat regen/colonisation is strongly preferred over planting to recover and expand CP (see 'Threats and mgmt.: planting'). Observed natural expansion in parts of Cairngorms (due to deer mgmt.) is also much greater than most people anticipated. CPR project found nat regen of pine 5 km from nearest seed source off the Larig Ghru. Review of evidence could inform revised planting/nat regen guidance for pine.	• Get seed viability trials for diff populations published. Does viability vary year-to-year? FR found Glen Loyne pines had low seed viability, but these have still naturally regenerated successfully where fences have held up – how much does seed viability actually matter for pine that is producing lots of seed (outside of nursery context)? • Evidence review around nat regen and expansion of pine to inform guidance. • What other species do we lose in the process of pinewood migration? Pine can adapt / move fast, other species may not. How much intervention required in the time between species re-establishing? Translocations of some species may be needed.
Cultural and historical values	• A History of the Native Woodlands of Scotland, 1500-1920 (Smout <i>et al.</i>) provides authoritative accounts of pinewood history for some regions. Fiona Watson's chapter on the SW pinewoods centred on Glenorchy is particularly thorough. • Past research by Brian Huntley and others found that peat-buried stumps in N Highlands originated between 3000 and 5000 years BP. Palynological work suggest asynchronous early pine decline across different regions. Early pine	• Attribution of pinewood decline is still not settled – role of climate change vs role of felling/burning/grazing. Current accepted narrative is that earlier pinewood decline (~4000 years ago) was largely due to climate change, while more recent decline was largely due to felling/burning/grazing. However, Smout postulates that the little ice age also caused decline, and this narrative is presented in A History of the Native Woodlands of Scotland, 1500-1920. This is at odds

	decline has been largely attributed to climate change. Does this still hold up as understanding of early peoples has improved? • Wild Pine project has identified aggregations of pine stumps outwith peatland and marks from fir candle making at many pinewood sites. A trial dendro study in collaboration with Rob Wilson at one site has found some pine stumps there were generated in the 15th and 16th century. Assumption is that these stumps were generated by past felling. • Stephen & Carlisle looked at pinewood history when assessing origin of different sites, Wild Pine project has added to this. Fiona Watson completed piece of historical research on some candidate wild pine sites. • Paul Kendall wrote a paper for the Woodland Trust about fir candles in 2015: 'Fir-Candles and the Ancient Woodlands of the Scottish Highlands'.	with discoveries made by Wild Pine project – large stump fields outwith peat in areas with relict pine, suggests historical decline driven by anthropogenic factors. • What can we learn about the history of these relict pinewoods from analysis of pine stumps? Dendro work on stumps across more sites could confirm anthropogenic origin and help us understand timeline of pine decline, including disentangling impacts from climate vs exploitation. Historical research could potentially link stump dates to specific felling events. • Review of pine declines through Holocene could be helpful and has important implications for restoration approaches. • Cultural value of fir candle trees and sites – further research on distribution of fir candle trees and their history could help connect people to sites so they are more invested in their recovery. • Importance of right framing for historical and cultural research – we should look at this in the context of the Highlands, where clearance has created a disconnect between people and trees and simplistic narratives around landscape that often erase past connection with woodland.
Threats and mgmt.: herbivore impacts	• CPR project identified levels of herbivore impact, primarily from deer, as main threat and barrier to recovery across Caledonian Pinewoods. Findings so far from Wild Pine project reinforce this. Woodland Herbivore Impact Assessment key evidence for this. • CPR project identified deer fencing as main management tool being used for pinewood recovery. However, effectiveness has been limited, particularly in the west where pine regen growth rates mean successful establishment takes longer than lifespan of most fences. Consequently, recovery often being reversed after decades of improvement. Mobility of pinewoods also limited to within fence. Found best recovery was taking place in areas with effective landscape-scale deer mgmt. • At the same time, vegetation recovery inside deer fences that have remained effective can be striking. Shows potential for recovery.	• Socioeconomic work around pinewood restoration – fencing off not as effective as anticipated – what impact has that on land managers on their perception of the future of pinewoods? • Acceptability of integrated land use. Speak to Kenny Hay - Kenny Kortland (SF) • Why is pine more selectively browsed in the south-west (compared to central)? Might need a lower deer density in the SW that say Cairngorms? Need to see the response in the west, haven't had landowners like Poulson, etc. Beinn Eighe in the west, didn't see the same selective browsing there. • More research on not just fence v. non-fence – but entire lifetime. Comparisons of systems of management, including cost components, landowner approaches. Look at some of the fences that have remained effective over 30 years • Understanding multiple herbivory impacts, interactions between deer & other grazers

	• Bunce resurvey highlighted decline of livestock grazing within pinewoods; main source of impact now deer. • Mike Daniels, Jessica Boucher, Richard Williams currently researching the costs, benefits, and trade-offs of deer fencing compared with alternative deer management approaches. • See also notes from Mike Daniels session • Common Ground Forum	• Knock on impacts of hyperherbivory (inc. selective) on inverts, vertebrates and fungi via vegetation.
Threats and mgmt.: non-native species	• Ron Summers published study on non-native conifers at CP sites, including presence within core, regen and buffer zones and highlighted barrier commercial plantations can pose to pinewood expansion/mobility. • CPR project found non-native trees/shrubs heavily concentrated on National Forest Estate CPI sites; implies key role for FLS in reducing threats from non-native species. Most non-native trees/shrubs within core pinewood are currently young, but impacts will increase in future if they are allowed to mature. Rhododendron an issue at some sites. The non-native subshrub Gaultheria was also flagged as an emerging invasive species in pinewoods, currently found at Arkaig and Glengarry. Early intervention could avoid more costly interventions in future. • Commercial conifer plantations in close proximity to CP are not just a problem for seed rain – they also make effective deer management more difficult as they are difficult to stalk, and clearfelling can generate irruptions of pine weevil that impacts regeneration of Scots pine (and sometimes broadleaves too). • Lodgepole pine plantations can also pose disease risk via Dothistroma, see 'Threats and mgmt.: pests and pathogens'.	• Review of impacts of non-native species and commercial forestry on CP would be useful, to include harbouring deer, pine weevil irruptions, and Dothistroma. Could inform zoning and felling practices for commercial forestry in landscapes with CP. Also see 'Threats and mgmt.: pests and pathogens'.
Threats, mgmt. and resilience: climate change	• Climate change impacts on Caledonian Pinewood poorly understood. Most likely mechanisms of impact are through more extreme weather events increasing tree mortality and wildfire risk, increasing temperatures favouring temperate tree species competitively over more boreal competition-avoidant pine, and increasing rainfall in the west leading to	• Better understanding and monitoring of climate change impacts on CP. • Can microclimatic refuges be identified for pine across landscapes? Could help prioritise where enabling of mobility is needed most. • See dendro work point in 'Regional differences'. If pine in west is suffering from increased waterlogging, are there

	more waterlogging which could reduce pine growth and vigour. • Evidence from Rob Wilson dendro work suggests the latter may be happening in western pinewoods (see 'Regional differences'). • Brian Huntley paper suggested Black Wood of Rannoch becoming more suitable for oak than pine using modelling approach, but field observations do not support this. CPR project found that where allowed to regenerate, CPs are still recruiting significant amounts of pine, except where selective browsing by deer is favouring birch in SW Highlands. • Resilience to climate change likely requires unimpeded natural regeneration to facilitate genetic adaptation to changing conditions, and mobility so pinewoods can 'find' parts of the landscape more climatically suited to them in future (e.g. microclimatic refuges or move upslope). • Some uncertainty around direction of climate change – could AMOC collapse? Adaptation and mobility strategies still cover for this. • FR have provenance trials in dry east of England to see if Highland-sourced pine can cope with conditions there – may be proxy for some parts of Highlands in future.	microsites that remain more suitable (e.g. steep slopes and knolls)? This would influence strategic response to the issue. • Is Scots pine adapting genetically to changing climatic conditions? If climate change is negatively impacting western pines, do these populations have sufficient adaptive potential to survive in situ where natural regeneration is allowed to take place?
Threats and mgmt.: pests and pathogens	• Main pests and pathogens potentially impacting Caledonian Pinewoods are <i>Dothistroma</i> needle blight and pine weevil <i>Hylobius</i>. <i>Curreya pithyophila</i> also possibly an issue, but practitioners think it has been long established and just overlooked until recently. It does not appear to be impacting Caledonian Pinewoods significantly. • Re <i>Dothistroma</i>, the main risk appears to be that the Lodgepole pine strain could hybridise with the native Scots pine strain to create a more virulent strain. SF policy has been to remove lodgepole pine from around CPI, and avoid planting of Scots pine close to CPI unless grown locally. FR looking at how you keep trees in good health (silviculturally), and University of Hertfordshire identifying mycovirus to develop ecologically neutral control.	• Zoning / buffers important for managing pest and pathogen risk for both <i>Dothistroma</i> and <i>Hylobius</i>. Is current zoning appropriate? SF guidance re <i>Dothistroma</i> and Scots pine only applies to CPI sites; Wild Pine sites therefore potentially at greater risk. • Is <i>Hylobius</i> negative impacting Caledonian Pinewood? Most research has been on impact within plantations. Anecdotal evidence that <i>Hylobius</i> may be preventing Scots pine regeneration at Invergaunan Wild Pine site in Glenorchy. Also regen at PAWS sites heavily birch dominated, could be partly due to <i>Hylobius</i> feeding on pine regen. • If <i>Hylobius</i> is negative impacting CP, may be better to clearfell large areas at once so impacts occur over a relatively short time, rather than coupes over several decades which could lead to prolonged impacts?

	• Re <i>Hylobius</i>, risk is to regeneration following clearfell of plantations in surrounding area (<i>Hylobius</i> breeds in conifer stumps, so population irruptions occur and subside usually within 5 years of felling). FLS are trialling leaving things fallow, thinking of the whole lifecycle. But that doesn't help the next-door pinewood trying to regenerate.	• More research on <i>Curreya pithyophila</i> to clarify whether it is a significant issue would be useful. • Other emerging pest / disease risks? Is Scots pine threatened elsewhere in the world by novel pests or pathogens, and if so could they arrive in Scotland / how do we stop them from doing so.
Strategic: site and mgmt. prioritisation, integrated mgmt. approaches	• CPR project highlighted importance of long-term landscape-scale mgmt. • Site prioritisation exercise to be undertaken through Caledonian Pinewood Partnership, including Wild Pine sites. • Wild Pine sites are just unrecognised Caledonian Pinewood – need for recognition, most obviously through Caledonian Pinewood Inventory. SF considering. Could highlight landscape scale potential better as many existing sites would be extended and new sites added. • CP is part of wider Ancient Woodland in Highlands. Need to consider together when planning mgmt. Completion of Ancient Woodland Register by NS to supersede incomplete Ancient Woodland Inventory will be helpful for this. • Importance of historical maps for identifying both Wild Pine sites and other Ancient Woodland fragments. 1st OS (~1870s) is exceptional. Zora ecosystems have digitised woodland polygons, but areas with scattered tree symbols not yet digitised. • See Dave Morris, Nick Kemp, etc. papers on CPI sites and their management.	• From 'Pinewood biodiversity': Understanding distribution of biodiversity hotspots is important for how we approach ecological recovery work – build outwards from hotspots, ensure management allows not just expansion of tree cover but expansion of whole ecosystem. How do we integrate what we already know about hotspots into policy? Can hotspots be mapped across Highlands? • Review of SF grant schemes will be taking place – need for strategic thinking to make way into this. At present, land managers submit grant applications with boundaries already drawn, but more ecologically important woodlands may exist on same ownership outside boundary. Planting is rewarded with higher grant rate and faster payments than nat regen projects. How do we ensure public money secures better ecological outcomes? • Site prioritisation – how do we balance urgent remedial work (often fencing) with shifting to landscape-scale which is ultimately needed? • How best to improve biodiversity of planted pinewoods? Important this is complementary to rather than competing with restoration of ancient sites. Best way may be to build outwards from CP and other hotspots, particularly through landscape-scale mgmt., which will pull specialist species out into surrounding landscape. Can then colonise formerly isolated plantations. Translocations may also be needed for some species. • May need a guide to strategic pinewood management. Could set out principles like hierarchical importance of restoring existing woodland before connecting up fragments (unless both can be achieved through landscape-scale mgmt.)
Pinewood managers	• Barriers Analysis as part of Caledonian Pinewood Recovery project	• What it means to restore Caledonian Pinewood is changing as we learn from what has and hasn't worked – fencing no

		longer considered sufficient to secure recovery, particularly in west. How is shift towards need for landscape-scale management perceived by pinewood managers?
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Invasive Non-Native Species (INNS)

Facilitator: Ian Dow, Argyll Countryside Trust

Note taker: Mareike Feldmann, The University of Edinburgh

Ian's intro (to all 4 groups)

Quantification – Clearance Methodologies – Ecological Legacy

- Quantification: Drones and ground work Rhodie and Exotic Conifers, Focus on Rhododendron ponticum
- Clearance: Multi-decadal pause in revegetation after Rhodie clearing even after 30 years
- Legacy: After Rhodie clearing local extinction of vascular plants and bryophytes and fungi
 - o Vascular plants and mycorrhizal focus

Revegetation:

“It’s not how you put it back, but why isn’t it there and how do we remove the constraint?”

- Why isn’t it there?
 - o Bryophyte mat, soil nutrients and chemistry, shade, leaf litter, saprophytes etc.
 - o eDNA analysis on uninvaded, invaded and cleared (1yr to 30yrs ago) sites
 - o Rhododendron leaf litter decomposition dependent on presence of saprophytic fungi

What are good methodologies to intervene?

- What are the effects and affects of Glyphosate?
- Ericoid fungi
- BioChar in combination with soil decompression
- Thermo-electric clearance methodology

Group no.	Past Methods	Current learning, trialling, researching	Future learning ideas, gaps, critical q's
Synthesis	Quantification Grounds Surveys	Quantification Drone and Ground Surveys	Quantification 1) Inclusion of LiDAR and Machine Learning algorithms and models

	Clearance Methodologies Clearance of Rhododendron ponticum only started 30-40 years ago, mainly by cutting and burning, as well as spraying with chemicals (eg. Glyphosate) Ecological Legacy	Clearance Methodologies Reformed existing methodologies to less harmful ways, including stem injection instead of spraying and mulching instead of burning Ecological Legacy Restoration and revegetation of cleared sites	2) <i>What is the measurable difference in accuracy between drone and ground work?</i> 3) <i>How can we give confidence to workers of the use and accuracy of drone work?</i> Clearance Methodologies 1) Chemicals: Foreseeable ban on chemicals like Glyphosate 2) Non-chemical methodologies and (re)invasion prevention needs to be investigated - Thermo-electric control already developed for herbaceous INNS - <i>How can we use it for woody plants?</i> - <i>Does Rhododendron have natural enemies that can be utilized for control?</i> - <i>How important a factor is Deer browsing in revegetation of cleared Rhododendron sites?</i> 3) Generational shift in private landowners may cause a surge in willingness to engage - <i>Is a one and done approach possible and if so under which circumstances in light of current political and legislative will?</i> 4) Prioritization - <i>How and where do we prioritize on clearance and management?</i> - <i>How do we determine likely sites of invasion and prevent it from happening?</i> Ecological Legacy 1) Possible utilisation of Rhododendron BioChar as soil remediation tool as a cost effective and logistically sane delivery of soil amendment - <i>Does BioChar help make tied up nutrients available again?</i>
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	Multidecadal pause in revegetation of sites after Rhododendron clearing - High risk of reinvasion on same sites - Soil has higher water carrying capacity. Potentially anaerobic - Local extinction of vascular plants, bryophytes and fungi - Rhodie was thought to be allelopathic for a long time, but current research suggests there is a mycorrhizal shift constraining recolonisation of native species - Leaf litter accumulation	- No current established process to initiate recolonisation of native vascular plant species	- <i>Is Rhododendron BioChar too acidic to use on its own?</i> 2) Faster litter layer breakdown - <i>How can we encourage fungal decomposition of INNS leaf litter?</i> 3) PR solutions for involvement of the public and politicians - <i>What narrative can be brought forward? "Beauty or the beast"?</i> - <i>Which economic incentivisation for companies and larger estates needed?</i>
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Group 1

Decompaction

- Use Rhodie to make BioChar
 - o More acidic than, so need to be combined with basic material
- Make a local workflow of clearing Rhodie and then using that to make BioChar

Fighting INNS

- Glyphosate might not be available so looking into other solutions NOW is necessary
 - o Has Glyphosate an impact -> there is sites that cleared Rhodie for 20 yrs without
- Using Thermoelectric (on Bracken, balsam and knotweed) which can break down soft roots/ rhizome based plants
 - o How can this be adapted for use on woody material?
- Need a multibranch approach
- Mycorrhizal modification of the soils through Rhodie, Sitka Spruce clearfell regenerate complexity under low browsing pressure

Effect of Deer

- Browsing is a big problem as well to bring back vascular plant and more biodiversity
 - o What is the difference in removing browsing?

Drone work

- SAMS revisiting areas with drone work multispectral on ground work sites
- LiDAR interesting – especially the official governmental dataset
 - o What is the difference between drone and ground work?
 - o How can we give confidence to workers of the use or accuracy?

Group 2

Questions for Ian

- Can you remediate the soil?
 - o Investigating use of BioChar and Decompaction
- How much are we prepared to accept invasion wise?

Clearance Methodologies

- Looking into differences of eDNA, but initially looks similar
- Effects on different sites, especially marine sites
- One and done approach
 - o How much would it cost to remove everything and then keep managing and monitoring for at least a decadal time?
 - o Unlikely this will work even in a perfect setting with political will and force unless this would be funded for the next decades
- What are natural enemies of Rhodie? Can there be a solution?

Invasion and Reinvasion

- Besides everything this needs to be a main concern at all times
- Big generational shift in private landowners atm with more awareness for climate change and biodiversity – could lead into shift of accepting INNS clearing on private land

Group 3

Questions

- Anecdotally after Rhodie clearance other invasives seem to come in, but no native species – Ian has not seen this
- Is Rhododendron allelopathic?
 - o Might not be, as it doesn't seem to be exuding chemicals, but just rather modifying soil ecology

Clearance

- Different revegetation observations – none to loads of birch, but whole of arc sites has no revegetation
- Where do we prioritize on clearance and management?
 - o FLS has prioritized their sites – could be used as an indicator?
- Winning some battles atm but are losing the wars

Research

- Scotland wide prioritization map of rainforests
- Methodologies and control (especially without glyphosate)
- Horizon scanning on invasive (all) prevention for the healthy part of the Rainforests

Group 4

Needs big PR push on how horrible INNS are

- Certain bee species are negatively impacted by Grayanotoxanes
- Look to Wales and Ireland to measurements and public engagement
- Economic incentivisation (BioChar for larger estates)
- Champion other species to use as Protagonist v. Rhodie as antagonist

- Black-faced sheep are used against giant hogweed because they're immune

Need PR for politicians and legislators to enforce fight against INNS

- Network rail and companies with lines either don't do anything or actually prefer Rhodie due to its characteristics of keeping away higher growing

Conservation grazing

Facilitator: Henry Dobson, Ardtornish Estate

Note taker: Rachel Orchard, The University of Edinburgh

Henry's intro (to all 4 groups)

- Public body/ eNGO land management background, now at Ardtornish estate
- Worked on 3 different conservation grazing projects with FR back at FLS in early 2000s
- At Ardtornish doing a breadth of different types of grazing: here's the headlines...
- Zoned Ardtornish into 3 areas of grazing (12k ha total), all rainforest in unfavourable condition due to too much browsing, Ardtornish tried to address this through fencing but then not enough grazing in those areas. So taking 3 approaches:
 - Regenerative grazing category – agriculturally improved ground, food production objective, elements of agroforestry and wood pasture
 - Protect & restore category – use conservation grazing as a tool, cows and ponies for trampling bracken and milium to create opportunity for tree regeneration and/ or wider biodiversity e.g. dog violet, bluebells. Rainforest where need more grazing to restore ground veg
 - Self-willed land – free-ranging ponies and cattle in a cultural connected transhumance project, people whose ancestors had been cleared from the land. Want more heterogeneity and we're brave enough to see how it develops and can experiment with numbers of livestock. "we're not brave enough to call it rewilding"
- All conservation projects I've managed have been hard to sustain long-term
- Since 2018 the estate has been reducing deer densities and taking sheep off the hill
- Executive proposal – broaden out discussion topic from conservation grazing to 'managing large herbivores in the landscape'

Group no.	Recently learnt	Current learning, trialling, researching	Future learning ideas, gaps, critical q's
Synthesis	Flexibility/ expanding habitat definitions – how this can influence more holistic landscape approach.	Learning ongoing about different types of grazing species – ponies more effective than expected; sheep more suited to pasture; cattle and bison uncertain impact on woodlands (depends on numbers and breed?); goats for scrub	1) More to learn around dynamics on cattle interactions with different habitats incl. Soil carbon, fire risk, topography: case studies please! 2) Tool for managers to help monitor effects of grazing – formalise expertise

	It's all about objectives! Move away from species-specific towards ecosystem/ habitat purpose to grazing. Successful way to engage farmers in conservation. But also need to make sure it doesn't get stuck in conservation/ commercial polarisation Trying to use existing metrics: e.g. Woodland grazing toolbox & soil association farmer-based tools	Technology increasing land accessibility: e.g. cattle collars Flying flocks vs. permanent use of grazing animals – what suits different objectives and landholdings? Where to trial? Could use rainforest as a sub-type of woodland to experiment in with grazing, then apply elsewhere? Link in with deer management approaches – understanding multiple herbivory impacts. Interactions between deer & other grazers	and unpublished evidence in accessible formats 3) Social research on conservation grazing practitioners' motivations, risks & opportunities; public perceptions of grazing and herbivore control incl. deer; neighbouring landowners attitudes for landscape scale approach? Traditional farming workers views towards conservation grazing? 4) Economic research – for evidencing the anecdotal benefits to make implementation possible 5) Location applicability, grazing management in commercial woodlands? In rainforests? 6) What does success look like for grazing in woodlands?
1	Redefining 'upland habitat' to include some trees, could be influential to grants etc.? Pull away from sharp distinctions between habitats – playing around with grazing is the key tool – help to re-shape how we think about landscape. Allows those objectives to be more realistic and not so blinkered and embrace more objectives with uncertain outcomes How cows are brought up and how that influences whether the animal can work in these difficult topography circumstances. Past experience: Bog/ heath site and trees establishing and we didn't want that so borrowed cattle with big horns – saw the cattle bring down trees with their horns to fell it and then eat the top of the trees. It would be really interesting to	Is there research comparing sheep or cattle hoof impacts on soil? – yes, sheep are selective eaters and feet are like stilettos – tends to be using sheep on pasture rather than woodland. Difficulty around whether there is space constraint with experimenting on smaller sites? Do regulations allow for exceptions from vet meds to cattle? Yes Using Bison down in Kent, they do the bashing through woodlands in the same way Been surprised by how effective the ponies are, better than cattle at getting at tufts – and they don't release as much methane as cattle. Switching to ponies? At Ardtornish 4 konic ponies, other highland ponies that have learnt from konic – need a	Impact on pine trees from big-horned cattle – what are the right numbers when they have the freedom and which breeds are best suited? Decision-support tool for assessing what is the right no. of cows? Wider collection of case studies of where grazing is being used – to go to and read about → bring them together for shared learning. Graziers' perspectives: Something around 'difficult land' and conservation grazing – wariness of graziers to put their animals on challenging topography, understanding conservation grazers' risks and concerns for different sites. Research on the new agricultural skillset and economics for conservation grazing contractors incl. motivators, what factors have allowed them to look into that as a form of employment.

	look at big cattle and tree felling – high impact on pine trees	primitive archetype. Marriage of archaeology and husbandry. Ardtornish/ Henry trying to develop a decision framework for helping inform no. of different kinds of grazing herbivores. Worry of public perception of controlling/ decreasing deer population. Re-frame it as changing the herbivores to allow some ponies. We can't take for granted the public license to operate – people are delighted to see them. → Woodland Trust survey of members that were more fine about deer control than expected.	Policy questions too... what are the contextual factors? Vet care for grazing animals: How much do we intervene with species that are meant to be stand-ins for wild animals? What are the impacts on invertebrates of grazing if animals have been treated e.g. vet meds? Risk of doing harm through vet meds? Does it make a difference to the woodland ecosystem if animals are treated? If they are an isolated herd, would they be more resilient and not need vet meds? Soil carbon – argument from regen ag that they help with soil carbon, but is it stable and what's the evidence behind that?
2	Bringing farmers along with conservation goals through maintaining livestock in woods – currently anecdotal learning, not official evidence Polarisation of conservation/ commercial camps but there is so much overlap – rebrand conservation grazing and/ or bringing element of farming into forestry SRUC example grazing densities – re. numbers of cattle you can put in (with production focus) without causing harm Survey and grazing research – Toolkit has become very deer-focused. Within rainforest and all woodlands need to pick up the biodiversity in all woods?	Using cattle collars rather than fencing to access harder to reach areas of bracken Gap between farming and forestry in policy & grants? Yes, there are a few niche opportunities but mostly enthusiasts trialling. S9 in 2008 was very unusual to allow forestry to pay for an animal grant. Difficulties with active farming defined by units. Imbalance of finance budget between farming/ forestry. Gov pushing to integrate but hard given the separate budgets – imbalance of huge landowners getting a lot. Ben Clinch, Moray estates, is doing a lot to take the lessons from conservation grazing to apply to commercial UKFS woodland areas. Flying flocks of goats/ sheep/ cattle you can rent in for a couple of weeks to mow scrub? SWT Use rainforests as a complex habitat – if you can get it right there then learn and apply for all	Experiment with putting cattle into commercial woodlands – is there reduction of fire risk? Encouraging continuous cover? Need to know the economic benefits of conservation grazing to see if the landowners can be convinced but also for policy, need to make an economic case to gov ministers. Is there a difference to habitat types? Riparian woods? Richness of soils and biodiversity habitats – some need grazing to make them more heterogeneous? What are the other management considerations that interact with grazing without full-time use (contract in for short-term). The cows are a mowing tool, what does that mean for other management onsite?

		woodlands elsewhere. Cautious about pigeon-holing but could be a way to get funding – transferable knowledge	
		Link in with deer management approach	
3	Past experience of conservation grazing at Arkaig – what worked? Continuity for about a decade and winter-only grazing; why didn't it carry on? Lack of staff continuity, hydro-scheme through research plots	Learning from Ardtornish plans – how are they measuring success? What are the attitudes towards them? What are the practicalities of trialing these different approaches?	RQ: Formalising from the data about regeneration to what is that for woodlands? Is that success? Is that meeting objectives? Social considerations – farming team reaction at Ardtornish? Neighbouring estate re. deer management reaction?
4	Ardtornish – trying to use existing metrics: e.g. Woodland grazing toolbox & Soil association farmer-based tools	Ardtornish - Not found anyone else using ponies in woodland before so interesting seeing that impact. Trying to encourage fire resilience of landscape. Doing modelling for where the ponies should graze fire breaks but also see where they want to go	Very few places feel they have the deer down to an appropriate level. Is it risky in intro the grazing of other mammals before the deer numbers are sufficiently lower? A decision-support tool for monitoring grazing impacts by managers – professionalise the 'stick finger in the air and see if it feels right' approach. People with grey lit and expertise, how to formalise that in an accessible format

Group 1

Practitioners' experience:

- I get asked a lot 'how many cows to put into the area?' as if there's a standard formula but an adaptive management approach of what to look out for in terms of monitoring would be more empowering e.g. a decision framework for land managers for informing no. of graziers → Henry says he is trying to develop one for Ardtornish
- It comes down to objectives, wary of term 'conservation grazing' because often playing god for a particular species. What are the metrics that will measure something a bit more holistic – species-specific or ecosystem level
- NatureScot taken decision to re-defined 'upland habitats' to say it's ok to have some trees – Henry: 'that's very radical!'
- Scottish forestry defines forestry as 20% canopy cover so it could also be upland

Q to Henry:

- Are you being targeted about it? E.g. area, no. of livestock, is it mob grazing approach?

- Response: both, where its dense bracken and milinea being targeted and then elsewhere give them more freedom and see where they go. Problem is we don't have resilient woodlands at the moment so couldn't deal with being beaten up with cattle – once more woodland connectivity that would cope with it.

Group 2

Practitioners' experience:

- Arisaig, farmer wanted to continue grazing wood pasture with cattle 2 weeks of the year and now has oak birchwood. Now looking at cattle collars rather than fences to access harder areas. Success because of cattle disturbing the ground, this was part of S9 grazing pilots from 2008
- If you can bring cattle into conservation then a way to get farmers along with you rather than taking all the animals – powerful tool to bring them in, but evidence is missing and its all anecdotal.
- Often not reducing deer numbers at the same time – linking deer management with grazing management to monitor both

Group 3

Q's for Henry:

- Controlled density?
 - Not a research experiment, monitoring sapling, milenia, graziers are leading on the monitoring so they can make the informed decision of when to move on. All livestock densities are very low (below claiming subsidy) e.g. only 6 ponies – open to a research question looking at that!
- What are the aims of the estate?
 - Carefully not using the word 'rewilding', in 2018 there was a big public consultation on what are the objectives of the estate? Maintaining robust farming business, natural capital based business model, self-catering with nature-connected tourism, trying to be a progressive quintessential west coast estate – Hugh would say 'nature recovery is our north star', cultural connection and existing farming team and stalkers are very important so not a total break towards rewilding, aspiration to make money from tourism.
- Is whole estate fenced?
 - No, fences around woodlands and some very remote – several very remote. Neighbouring estates not delighted about low herbivory impacts
- How do neighbours perceive your approach relative to theirs?
 - Some of them find it challenging, their message is we're doing good for biodiversity by fencing small areas but maintaining the Victorian tradition. Very personality driven.
- Is farm business run internally, how have they taken to it?
 - Yes, 2 have decided to leave, 2 have decided to stay and have got behind it including expanded roles to run with regenerative approach – shepherd and cattleman is behind it. SRUC were used by predecessor but they weren't suitable, Henry has used Caroline Rindrod who is the one consultant that does large-scale grazing projects. Some are external graziers, not directly from a farming background and have innovative ideas – pre-industrial agricultural. Crucial about the people, a lot of the past projects were designed by ecologists and delivered by farmers and they didn't speak the same language.
- What does success look like?

- The metrics are quite simple, success would look like trees and woodland flora regenerating, regeneration still happening in existing woods whilst having existing glades and not all burning down. Success might look like needing to be less precious about being so rule-based and constraining where the animals can go and that the landscape and woodlands develop around those influences from grazing. That's my personal vision and the funders.
- How does that compare to Arkaig re. natural regeneration?
 - Year-round grazing so little trees were not getting away but the butterfly folk were happy. In half-year grazing (winter only), more trees got away and then it was really patchy which I think was really good. It was quite hard to measure because the average stem density looked like it was high but it was so patchy. My personal wood pasture objectives were met.
- What happened at Arkaig? Continue monitoring?
 - Hydro-scheme being built through the middle of research plots – was it about the people? Yes, FLS but then they went for leasing. Continuity was pretty good for 10yrs and then staff change and have struggled since.
- Do you have boar? Sorry feral pigs?
 - No but my deer stalker and I have a secret plan to introduce some in a pen. Already brought in wood ants and ??

Practitioner experience:

- Grouse, a bit of disturbance but that is species-specific approach so very different

Group 4

Q's for Henry:

- Is there altitude at Ardtornish?
 - Very coastal, only goes up to Corbet height.
- Is approach to grazing drawing on research?
 - Yes, drawing on unpublished research – previous experience from 3 conservation grazing research projects (personal experience with these when working at Arkaig). In early 2000s, Forest Research had a whole programme on grazing but then it disappeared.
- What if there are negative impacts?
 - If they start stripping the bark then they'll have to be moved, so having said there is minimal bureaucracy, there is still a lot of consideration of what is appropriate where e.g. SSSI's.
- Very few places feel they have the deer down to an appropriate level. Is it risky to introduce the grazing of other mammals before the deer numbers are sufficiently lower?
 - Ardtornish will pilot for 2 years with the grazing, ponies only been there for a few months; put in a strategic fence – plan to hammer the dense bracken first. Predecessors said focus on reducing deer but in position of lichenologists (Oliver Moor) saying you're trashing woods. Introducing other grazing animals helps with those neighbours who are suspicious of eradicating animals from the landscape – shows we love animals and are increasing the diversity of the land, message of seeing deer as part of the landscape – makes a simple message about 'shooting the deer' more nuanced.

Practitioner experience:

- WT been grazing cattle in 5,000 ha of wood pasture site. A lot of upland and deep peat on the site. Principal is to allow the cattle to roam – prioritise deer as being the primary grazers and then cattle as the intro of dynamism. Justified farming as WT by it being wood pasture. Tricky thing is there is no prescription for it – how many animals should I put there? Entirely dependent on site, on observation & adaption.
- Ancient pollarded hazel and alder with lichen assemblages. Since reducing the grazing, the thickening of sites with vegetation but not so great for the lichen in the short-term. Stick finger in the air and see if it feels right approach.

Other:

- Is there much research on fire? Gail in CC is interested in that and Mareilla Marzano at FR is keen to do some fire research. Forestry Trust has funded a piece of research – bringing a Canadian model over to looking at Scotland context.