NATURE CONNECTIONS:
working together to enhance Scotland's environment, biodiversity and resilience to climate change

Workshop Report

March 15th 2017, Edinburgh Centre for Carbon Innovation

Co-organisers: Alison Hester, Deborah Long and James Curran

Contact: alison.hester@hutton.ac.uk

The James Hutton Institute

NATURE CONNECTIONS: working together to enhance Scotland's environment, biodiversity and resilience to climate change

Workshop Report

Contents

Summary

This report summarises the contents and outputs from the connectivity scoping workshop: held on 15th March 2017 at the Edinburgh Centre for Carbon Innovation, led by the James Hutton Institute and supported by ESCom and Scottish Environment LINK.

The international Convention on Biological Diversity targets call for a dramatic step forward in action to halt the loss of biodiversity and restore essential services that are provided by a healthy natural environment - this is becoming increasingly urgent in the context of climate change and the accelerating degradation of natural resources across the globe. Scotland has a unique opportunity to create a new strategic, national approach, aligning all the key partners through co-ordinated actions to support the delivery of ecological connectivity across Scotland.

This scoping workshop brought together c 50 people to share knowledge, integrate different initiatives and help progress a new strategic national approach (in support of the National Ecological Network), underpinned by strong science supported by the Scottish Government's Strategic Research Programme and other funders.

There has been much exciting progress in Scotland since the ground-breaking conference in Edinburgh in February 2013: "Towards a new national network for Scotland", organised by the Scottish Wildlife Trust. Now is a good time to update, take stock and work together to maximise the value of the work that is being done and coordinate future plans.

There are powerful opportunities for integrated research, land-use planning and land management to focus action to restore Scotland's ecological connectivity and promote the potential for economic as well as environmental benefits in the context of the multi-functional demands on our land.

Workshop aims:

- **To raise awareness of research that is being done on connectivity through the Scottish Government and other funders**
- **To share knowledge and experiences between the many different projects actively promoting connectivity across Scotland**
- **To help find ways for people to work more closely together towards a new national approach – there has been much discussion on this over recent years, and the aim of a new National Ecological Network is firmly written into Scotland's national plans.**

Workshop Programme

The programme featured four keynote presentations setting the context, followed by 11 showcase-talks outlining a range of exciting initiatives relating to connectivity across Scotland. In the afternoon we broke into groups to focus on key issues, share knowledge and define priority actions.

	Programme (see Annex 1 and 2 for copies of presentations)
9.30-10.00	Registration and coffee/tea
10.00-10.10	Welcome and aims (Alison Hester)
10.10-11.10	Connectivity in context - the need for a new approach: - Drivers for change (James Curran: SE LINK; James Hutton Institute Board) - Ecological networks: origins and international context (Alessandro Gimona: James Hutton Institute) - Testing times: testing biodiversity (Deborah Long: SE LINK; Dundee University) - Ecological connectivity and networks – current SBS activity and next steps (Pete Rawcliffe: Scottish Natural Heritage)
11.10-11.30	Coffee/tea
11.30-12.45	Short showcase-talks of existing initiatives: - Irina Birnie (Aberdeenshire Council) - Louise Bond (SEPA) - Vanessa Burton (Edinburgh University) - Jan Dick (CEH) - Chris Ellis (RBGE) - Justin Irvine (James Hutton Institute) - Derek Robeson (Tweed Forum) - Paul Sizeland (SNH) - Andy Tharme (Borders Council) - Kevin Watts (Forest Research) - Bruce Wilson (Scottish Wildlife Trust)
12.45-13.30	Lunch
13.30-14.30	Breakout sessions – scoping the way forward:
	a) Data, approaches and tools
	b) Planning and policy
	c) Communities
14.30-15.00	Coffee/tea
15.00-16.00	Plenary Discussion - next steps (Susan Davies)

Connectivity in context – the need for a new approach

The four invited keynote presenters: James Curran, Alessandro Gimona, Deborah Long and Pete Rawcliffe introduced the context for this workshop, highlighting the timeliness and critical importance for Scotland to coordinate action to improve ecological connectivity, addressing biodiversity loss, environment and resilience to climate change (see Annex 1 for copies of presentations).

Global context

A recent survey of global public opinion rated climate change as the greatest threat, ahead of economic instability and terrorism (Pew Research Center 2014). For this reason, 187 countries agreed in Paris in December 2015 to keep global temperature increase below +2^{o}C, with legally binding carbon emission reductions from 2020 onwards. However, there is emerging evidence (Curran and Curran, 2016a, 2016b) that climate change is already damaging the Earth's ability to absorb CO_2 from the atmosphere, which will further exacerbate climate change impacts. The Climate Change (Scotland) Act 2009 set challenging targets ahead of the Paris agreement, and Scotland continues to play a leading role in tackling climate change.

There are fundamentally only two ways to combat climate change: reducing emissions (the focus of the Paris agreement); and ensuring the 'health' of global biodiversity and ecosystem functions, which include carbon sequestration and many other critical processes. Global biodiversity is continuing to decline at an alarming rate, with climate change adding additional pressures on top of human activities. Continuing biodiversity losses lead to reductions in many critical functions and processes, including CO_2 absorption from the atmosphere, with, of course, knock-on effects on climate change.

There is much evidence and consensus (consistent with the aims of the EU Habitats Directive) that biodiversity conservation should expand its remit from nature reserves and patch-based management to the wider landscape (e.g. Lindenmayer et al. 2008; Lawton et al. 2010; Gimona et al. 2012, 2015; Haddad et al. 2015), paying particular consideration to **habitat connectivity**. A big challenge here is to find ways of conserving and enhancing biodiversity and ecosystem functions across the whole landscape, not just within protected areas, which combined cover a very small, mostly highly dispersed, proportion of the land. Scotland's policies relating to forest expansion and multi-functionality, together with the agri-environment stipulations in farm payments, give a strong base on which to build a coordinated approach to enhance the functioning and resilience of our natural systems in the face of both current and future pressures.

Habitat connectivity and ecological networks

The concepts of connectivity and ecological networks are not new - they have been variously considered for at least the last 50 years and there are opportunities to learn from

different approaches and experiences elsewhere in the world. An important take-home message is that implementation is much more difficult than articulating a vision!

There are several major factors that need to be considered if connectivity is to be improved across the wider countryside. First, increasing connectivity for biodiversity and the associated ecosystem functions needs to be reconciled with multiple land uses such as farming, forestry, recreation, housing. Second, solutions for land use composition and configuration need to take account of the fact that climate change will drive further changes in habitats and the species they support – so actions taken need to account for the present *and* future ability of landscapes to provide multiple benefits. Trade-offs must also be carefully considered: improving connectivity in one habitat may be associated with a decline in connectivity of another.

Scotland as a world leader

Scotland is known for its world-leading ambitions in carbon emission reductions. There is a real opportunity for Scotland to enhance its status as a world leader on climate change by also leading the way in action for ecological resilience and biodiversity conservation in this country of highly managed, multifunctional landscapes, well beyond the 'borders' of protected areas.

The development and refreshment of Scotland's Land Use Strategy (2016-21) and the Scottish Biodiversity Strategy give a vision and a strong framework for a new, whole-Scotland approach to the integrated management of land and natural resources, through the implementation of a National Ecological Network. Successful implementation will require active integration with the planning system, supporting more informed decision-making through the development of public-private land use partnerships and effecting real change on the ground.

Showcasing existing initiatives

For session two of the workshop, we invited speakers from different organisations to showcase a diverse selection of exciting initiatives relating to ecological connectivity that are being carried out across Scotland, from research through to on-the-ground action.

Speakers were asked to summarise their work in 5 minutes, outlining:

- what their organisation has done/is doing relating to connectivity
- what location(s) the work covers
- What methods/tools are being used.

Copies of these presentations are in Annex 2, and all have included their contact information to facilitate further exchange following the workshop.

Research organisations showcasing their work on connectivity included James Hutton Institute, Royal Botanic Gardens Edinburgh, Edinburgh University, Forest Research and CEH. Initiatives and action showcased included the EcoCo Life project; Land Use Pilots and follow-on activities; Living Landscapes; Partnership projects and Green Networks; integrated catchment management initiatives.

The diversity of approaches, scales, governance and actors was strongly apparent and this gave much fuel for discussion for the afternoon Breakout sessions.

Breakout Sessions – scoping the way forward

The three breakout sessions were designed to share knowledge and experiences of some of the key issues of importance in progressing a National Ecological Network for Scotland.

Discussion topics were selected to inform both action 'on the ground' and future research directions (each breakout was led by a researcher working on the Scottish Government-funded Strategic Research Programme).

The three breakouts explored:

a) The availability and functionality of data, approaches and tools
b) Requirements for planning and policy
c) Working with local communities to action a National Ecological Network.

In the spirit of using this workshop to promote action-based progress towards a National Ecological Network, all breakout groups were tasked to define and agree three Priority Actions to be brought to the final Plenary ("what, by whom, when").

a) 'Data, approaches and tools'

Led by Marie Castellazzi, Alessandro Gimona and Carol Kyle (James Hutton Institute)

Objectives:

- **Share information on tools and data that are being used/developed relating to ecological connectivity**
- **Discuss key issues and requirements for those tools and data to deliver to the needs of connectivity planning; outline benefits and limitations of different tools and data - consider at two scales: local to national**
- **Discuss and agree how data and tools can be brought together and/or made more compatible, so that they can be better used to help improve connectivity in whatever form that might take**
- **Identify Priority Actions for the final Plenary (what, by whom, by when).**

Marie Castellazzi gave a short presentation showcasing new sustainable land management options tools being developed at the James Hutton Institute, as part of the Scottish Government's Strategic Research Programme (WP1.4.2) and National Trust funded work. This introduced key requirements and features of data and tools in the context of landscape multi-functionality, to stimulate discussion (a copy of this presentation is in Annex 2).

Tools and datasets

The group discussed the following issues:

- **Tools:** what tools are being used by others in the room; what are their strengths and weaknesses (and why)?
- **Data use and limitations:** what data are people using (species; habitat); what are current limitations/gaps?

A variety of tools and datasets were highlighted as useful for planning a wide-scale connectivity network in Scotland (Table 1). Some supporting policy documents were also

mentioned. The most frequently-used data were: the Native Woodland Inventory of Scotland (NWSS) and NFI; land cover data (e.g. LCS2007, EUNIS); the data associated with ECOSERVE; and the NBN.

As well as software tools to measure connectivity and fragmentation, a variety of other modelling tools were mentioned. These can help to better understand the context in terms of ecosystem services. Participants also highlighted the importance of planning. They mentioned the need to incorporate some existing initiatives, for example local woodland strategies, and also the need to follow participatory approaches and approaches that look at the future (e.g. because of climate change).

Table 1. Tools and datasets – strengths and weaknesses

Tool	Type	Region	Strengths	Weaknesses
SNH peat soils map	Data	National		
Ancient woodland inventory	Data	National		Gaps. Does not account for individual ancient trees
SEPA water quality data	Data	National		Interpretation of pressures
Native woodland survey Scotland	Data	National	Condition of information incl. INNS & deer (herbivory)	Woods min area is 0.5 ha so no data on individual trees. No commitment to restoration (yet). INN affected by surrounding land use change so require large scale updates.
Black Grouse Wild Challenge priority map	Planning	Local	Partnership/ local consensus	
LA planning management tools	Planning	Local	Strategic and development management	
Scottish Borders Woodland strategy	Planning	Local	[No comment]	
BIOCORE (FR) Biodiversity coherence resilience	Planning	Local	Highlights habitat patches to focus on for targeting networks	More work to be done on prioritisation?
NEBCCUM (Natural England Biodiversity Climate Change Model)	Planning	National/ local	Flexible; variety of habitats. Incorporate multi criteria e.g. management and condition. Easy to use. Can be used for repeat measurement	Relies on nationally available data sets which requires updating
Participatory mapping	Planning	Local	Inclusive. Captures non-RS data; stakeholder knowledge.	Subjective

			Communicative results.	
Woodland/ forest ES models (FR)	Planning	Local	Being tested in a number of areas	Need to consider ES for other land uses - comparison/ trade-offs
Water framework directive	policy document	EU	Good piece of legislation	
Scottish Borders Woodland strategy	policy document	Regional	[No comment]	
Conefor	software tool	Landscape to national	Rapid assessment. Assessment of habitat change effects. Communicable results.	Data preparation time-consuming. Computationally intensive: large areas difficult
CircuitScape (based on Circuit theory)	software tool (connectivity)		Multiple paths	Hard to know habitat/ landscape permeability
IHN Tool (SNH)	software tool (connectivity)	National/ local	Easy to run. Visual mapped output. Use at any scale	Binary output. Dependant on assumptions of spp. Movement. Some habitats missing
Fragstats	software tool (fragment'n)	Landscape to national	Rapid assessment	Data preparation time-consuming
SLM options tool and Landsfacts	software tool (land use change options)	Large landscape	Accounts for multiple land uses and functions. Spatio-temporal. Fast. Requires background/ initial LU map.	Connectivity as input not as output. Can require specialist model knowledge to set up.
ECOSURV GIS (ES measure)	Suite of ESS models	Local	Provides graphical map-based measure of ES contribution	Requires expert GIS operator, understanding of results and how generated. Needs reliable background data; rules need validation. Relative values only - not compatible across regions. High staff time/data needs
InVEST	Suite of ESS models	Regional to national	Low parametrisation. Wide use.	Requires expert GIS operator, understanding of the results and how generated. Needs reliable background data.
Netlogo	Tool to program agent based simulations	National	Ease of application. Agent based. Common platform	Connectivity to be measured on the output. Can become overly complex very fast
Crafty (Edin Uni)	Tool to program agent based simulations	National	Agent based. Effect of landowner decisions/policies on LU change. Opportunities to link with ES models	Connectivity to be measured on the output. Needs parameterisation with agent or stakeholder behaviour
Spatially explicit simulation coded in GIS	Computer code or graphical model	National	Bespoke development Theoretically robust Clearly stated assumptions	Time-consuming and knowledge intensive

General Comments:

- Having Nationally available Phase 1 habitat and land use data would be useful, e.g. IACS
- There is a need for more widely and consistently usable datasets across Scotland, not just usable locally
- What tools can support dialogue across stakeholders to give common ground? This would be of great value.
- Many felt that the use of a number of rapid complementary approaches and tools could often provide initial results fit for purpose. These could be refined using the more sophisticated and time-consuming approaches which require more time, expertise and data.

The most frequently highlighted limitations of the tools and datasets discussed include: incomplete data; data scale (often too 'general' for specific local applications); the need for considerable expertise and time investment for some tools; cost and lack of updates. A small number also listed accessibility and licensing as a limitation to wider use.

The main gaps-issue highlighted was the gaps in coverage of some existing datasets.

How to bring data and tools together

This exercise focused on how to bring together the best data and tools (either generically or specific purposes and scales), identifying:

How this could be done – suggestions made were:

a) Incorporate National Ecological Network planning and support mechanisms into the SRDP (or future equivalent) via online portal
b) Create a data inventory, picking the best data available to inform NEN activities (note to inquire to SBS Landscape Scale Conservation group re plans for SE Web page on landscape scale conservation data)
c) Maximise availability of 'open data' and create a project and tools inventory for ease of knowledge-sharing (links to Land Use Strategy plans and procedures http://www.gov.scot/Publications/2016/03/5773/4).

Who would need to be involved – it was felt that Government agencies and NGO/ landowner collaborations were essential for success, underpinned by strong data and tools.

What else would be required – this brought out the importance of defining exactly what 'answers' are being sought from the data and tools. The concept of a National Ecological Network for Scotland is still being developed, and without clarity of purpose and outcome, it is very hard to define what will be required from tools and data. Once this is achieved, some sort of facilitation of the process was identified as critical to guide action and achieve buy-in, nationally to locally. Funding was also identified as a critical requirement.

By when – most of the group felt that 2020 was an appropriate date to aim for to have a tool and a clear plan in place (Brexit, CAP, SRDP and beyond…)

b) 'Planning and Policy'

Led by Paula Novo (James Hutton Institute) and Daphne Vlastari (SE LINK)

Objectives:

- **Explore experiences with different governance mechanisms in the context of ecological connectivity**
- **Discuss processes and challenges for successful implementation - consider at two scales: local to national**
- **Identify Priority Actions for the final Plenary (what, by whom, by when).**

Governance mechanisms relevant to ecological connectivity

Paula Novo presented a list of governance mechanisms, based on a review carried out for the Scottish Government's Strategic Research Programme (Workpackage 1.3.4) and the group discussed their importance for ecological connectivity. The diversity of relevant mechanisms was noted – Regulations (e.g. Directives); provision of services by Government (e.g. (Whole Farm Review Scheme); Economic instruments: market-traded (e.g. biodiversity offsetting) and not traded (CAP greening, Ecological Focus Areas); 'voluntary efforts' (e.g. consortium partnerships such as Living Landscapes and Green Networks); other collective actions (e.g. environmental cooperatives).

Participants were then asked to write three positive and three negative examples of a governance mechanism that in their experience works, doesn't work (or could work) for

connectivity. They were asked to place their examples in a diagram showing on the horizontal axis whether the example is positive/negative and on the vertical axis whether it is a local or national example (Fig. 1). The group then discussed those mechanisms with the most positive/negative positions (at both ends of the scale axis) and those clustered around the centre.

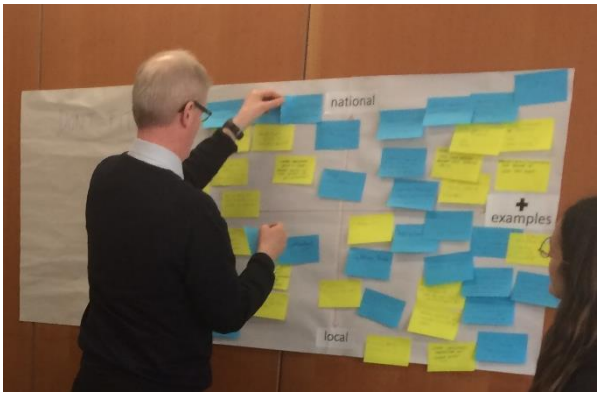

Figure 1. Participant scoring of governance mechanisms in relation to connectivity (see Table 2 for number codes).

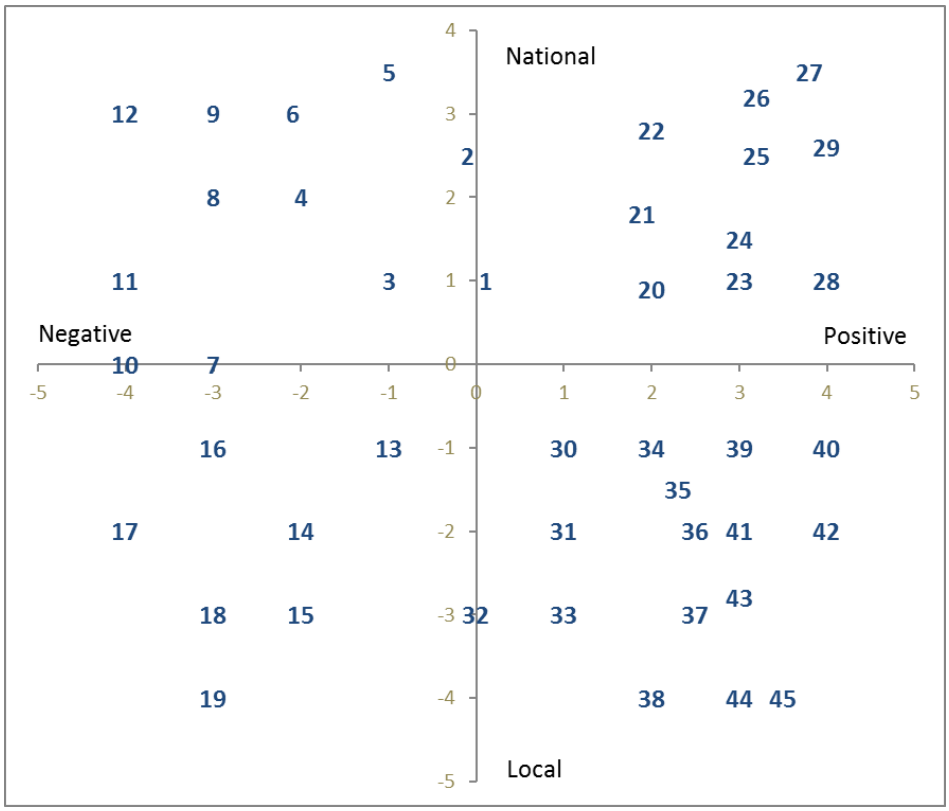

Table 2. Key to number codes used on Figure 1

		Mechanism	Code Fig. 1
Negative	National	ECAF - now withdrawn	1
		Protected Area network	2
		CAP-SRDP funding - skewed to rural business over agri-environment?	3
		Habitats Directive limitations, e.g. Article 10 inadequately implemented	4
		Markets geared towards food and timber production - need to include/develop markets for other ES (e.g. flood protection, water quality)	5
		Planning policy national-local: no protection for habitat networks (except CSGN)	6
		Loss of one-to-one advice for farmers when FWAG was closed down	7
		Biodiversity Action Plans (national + local)	8
		National Planning Framework	9

		Regulation of deer management by "Section 7"	10
		Lack of vision or target for moorland or other priority habitats	11
		SRDP Single Farm Payment / Basic Payment Scheme - degrading habitat networks	12
		NE Green Network	13
	Local	Examination of species/ habitat impacts from built development by governments (Dept. of Planning & Environmental Appeals)	14
		SRDP	15
		Existing UK Govt City Deals (Glasgow, Inverness, Aberdeen)	16
		Advisory services - need more!	17
		Weak/partial policies affecting ecological connectivity in local development plans	18
		GI/GN policies being 'trumped' by others (e.g. economic devel., roads policies)	19
		Important Plant Areas + Forest Habitat Networks (same approach)	20
Positive	National	Woodland expansion targets lead to planting, but connectivity only where there is a locational premium	21
		Forestry Grant Scheme / Woodland strategies - but not necessarily integrated LU	22
		SEPA Diffuse Pollution Priority Catchments	23
		Campaigning - Wild land areas brought into planning policy	24
		Water Framework Directive	25
		Wildlife/environmental advisory service (as FWAG used to do)	26
		Embedding Green Network GI into NPF 2/3 and SPP	27
		Outdoor education/conservation, e.g. SNH funding of John Muir Award	28
		Flood management legislation	29
		Demonstration farms	30
		Tay Estuary Forum	31
	Local	National Designations	32
		Volunteer involvement in monitoring and enhancing biodiversity, e.g. Dean Castle Country Park, Kilmarnock	33
		Forest & Woodland Strategy	34
		Catchment management planning	35
		Natural Flood Management: part of Local Authority Flood Risk Management Plans	36
		Statutory requirement for Sustainable Urban Drainage Systems	37
		Living Landscapes Partnerships e.g. Coigach-Assynt	38
		GCV Strategic development planning policy to embed green networks in the regional plan	39
		Forthcoming UK Government City Deals - Stirling, Tayside, Edinburgh	40
		Biodiversity offsetting, e.g. Scottish Borders - targets resources to deliver habitat network + multiple benefits	41
		LBAPS and Catchment Management Plans (e.g. Tweed) can provide framework for coordinated action and delivery of habitat networks	42
		East Renfrewshire's development of G.I. supplementary planning guidance and development framework for major developments based on Green Networks	43
		SNH guidance on location of small-scale hydro-schemes	44
		Living Landscapes Partnership - semi-govt + others	45

The group were then asked to consider together what criteria they used to define a positive/ negative experience in relation to connectivity; what trade-offs might be implicit (e.g. with other goals, uses, benefits).

Processes and challenges for successful implementation

Open discussion on the governance examples above led to the identification of the following main 'challenges' in relation to implementation:

- There is currently no defined, easily measurable target for assessing connectivity
- Multi-level governance is needed, both top-down and bottom-up
- There is a gap between theory and practice, i.e. delivery of what is 'on paper'; and a problem of lack of detail or over-complication in policies and development plans
- Legislation should be mandatory with standards and identified delivery mechanisms, i.e. there is a need to change from "should" to "must" (e.g. WFD has a set of Standards which must be delivered. Similarly, "no net loss" for biodiversity)
- Ecological planning policy goals are perceived to be trumped by other policies/considerations
- Targets for ecological health need to be better defined (e.g. Natural Capital Asset Indicators).
- There is a strong need to increase provision of relevant training and advice (university/training, education; advisory services) across professions.

c) 'Communities'

Led by Scott Herrett and Louise Ross (James Hutton Institute)

Objectives:

- **Discuss the biggest issues for ecological connectivity regarding the values and practices of land users and managers**
- **Share examples where biodiversity and connectivity challenges have been tackled well or not so well, and examine why**
- **Discuss what knowledge we already have about how best to engage land managers and users in improving connectivity and what are the biggest knowledge gaps**
- **Identify Priority Actions for the final Plenary (what, by whom, by when).**

Big issues for connectivity regarding the values and practices of land users and managers

Decision-making is, of course, strongly influenced by individual as well as collective values, and this can present major challenges when trying to design a national level approach to a new land management initiative. Land management objectives and practices differ; cultural values and associations differ; and all of these can change over time. This can produce conflict of values and perceptions can hamper (or halt!) collective progress.

The group highlighted the problem of lack of knowledge of how to manage land to increase connectivity (what takes priority?), benefit biodiversity and/or resilience to climate change – for example "how can management of my hedges, ponds and verges affect the bigger conservation picture?"

There is a strong need for leadership and resources to inform and sustain effort and investment. Tackling incentives that currently discourage working towards multiple benefits for many people should also be a priority – an integrated land use strategy is critically important. Collaborative business models were also suggested as a useful approach to consider.

Engaging land managers and users in improving connectivity

The following needs were highlighted:

- Proactive Plans that are local and prepared by the communities, combined with individuals who can lead
- 'Carrots and sticks' – i.e. financial Incentives as well as regulatory requirements
- Identifying common goals, reasons and benefits (both environmental and economic) for working together to improve connectivity – people need to be interested and motivated to take the time to come to the table and talk about this
- Valuing small contributions and showing how they all add up to something bigger (i.e. acknowledging all action – whoever does it, it is important).

Many of the issues discussed that might hamper engagement and action related to the lack of an overall vision (and tools/data to aid visualisation as well as implementation), time, resources, and individual circumstances and priorities. For example: a lack of community/government capacity, limited facilitation and networking opportunities, and a prevailing land use 'silo' mentality were highlighted. Lack of resources can be both social and economic, and related to this, there is a need to also identify and promote

business/economic benefits. Individuals' personal views and circumstances can change, and recognition of this is also critical – failure to engage people regularly and fully is considered a danger to progress.

Examples where biodiversity and connectivity challenges have been tackled and implemented well and not so well and why

Many examples were given (some generic, some specific), but a key point also made is that the definition of 'done well' is, of course, a variable value judgement! Generic examples of benefit included implementation of the Ecosystem Approach, and participatory budgeting to allocate scarce resources. Specific examples reflected the diversity of successful action across Scotland and included the following:

- Cairngorms National Park: - many examples given – e.g. community action planning (community visitors); HLF project (successful because it brought in resources to take forward actions); point also made that need to understand who makes decisions on land. – Factors? Owners? Gamekeepers?
- Numerous examples of collaborative 'action on the ground', e.g. Eddleston Project (Tweed Forum), Carse of Stirling, Cumbernauld Living Landscape, Glasgow Clyde Valley; River restoration projects
- Barn owls in lowland Scotland (LBAP initiative)
- Water vole reintroduction/conservation, especially the volunteer engagement in this work – e.g. locating and trapping mink (Xavier Lambin)
- Amphibian ladders installation in gullypots – great interest from local authorities all over Scotland + northern England (needs external funding, though).

Examples of where biodiversity and connectivity challenges have not been implemented so well brought out the following generic issues, with examples given:

- Many single issue or single sector approaches - i.e. lack of multifunctional/multi benefit approach (e.g. some aspects of 'pearls in peril'). Separating the planning system from "land use strategies" makes no sense and does not help communities nor professionals
- Short term nature of many projects (e.g. Carse of Stirling) and lack of funding continuity (e.g. green graveyard initiative example – very well received and managed but only as long as funding available). Lack of ongoing funding/maintenance undermines further good quality management
- Lack of engagement/ willingness/ institutional flexibility to change methods of management (e.g. community keen to help with practical work on improving verges/planting wild – flowers areas, but local authorities unable to do their part)
- Poor design/implementation of legislation for nature-based solutions (e.g. sustainable urban drainage systems (SUDS) for new housing development are considered badly designed).

Engaging land managers and users in improving ecological connectivity – knowledge and gaps

The following were highlighted as examples of useful knowledge that has guided land managers and users well in relation to ecological connectivity: the Land Use Strategy Pilots; Living Landscape visioning exercises; and Core Paths planning, which was given as a good example of how a National Ecological Network could be delivered.

Examples of 'gaps' included the lack of shared understanding/consensus about why improving connectivity is important, and the rarity/difficulty of sharing experiences across initiatives. Linked to this, there is a lack of sharing of 'top tips' to engage and communicate key messages about ecological connectivity. Also felt to be lacking is awareness/promotion of national and regional strategies, how they are relevant at a local level and, importantly, how local action can be implemented. The creation of 'opportunity maps' across different geographical scales were suggested as an important requirement, as nothing like this currently exists for all of Scotland.

Plenary Discussion – Next Steps

This workshop provided a forum and structure to raise awareness and share knowledge and experiences relating to connectivity research and action across Scotland. The global challenges and their importance for Scotland were clearly set out by the keynote speakers at the start of the meeting. The evolution of approaches to connectivity across the world and the urgent need to address this issue were also well illustrated. The issues and opportunities for Scotland were clearly outlined and have been examined further in the context of the different breakouts.

The quick-fire case-study presentations highlighted the breadth of research and wealth of initiatives which are under way – and participants welcomed the opportunity to hear about the range of initiatives. But this workshop also brought into focus the lack of any formal oversight and/or co-ordination and targeting of the different initiatives at a whole-Scotland level, and the strong need for robust research, data and tools to support both ongoing and new initiatives. This report gives a source of information and contact details (Annex 1 and 2) for all the initiatives presented at this workshop, but of course this was just one workshop with a subset of all the people and organisations working in this area, and there are more initiatives that were not represented.

The main focus of this final plenary session was to collectively identify priority actions to directly help progress towards a National Ecological Network for Scotland, bringing together the issues discussed in the morning presentations and the afternoon breakouts. Breakout leads shared their three Priority Actions and these were discussed and distilled

into the list in the box below. Wherever possible each Action has also been given a 'lead' and a timescale.

Priority Actions:

(1) A clear narrative is required which sets out what the National Ecological Network should provide and how it could be incorporated into national policy and implemented through Regional Partnerships. Having a common language and understanding should help with advocacy work on the NEN **(Lead: SNH – Pete Rawcliffe - working group to be established by end of June 2017).**

(2) Delivery must be at an appropriate geographical scale and focus on delivering multifunctional benefits. Scotland's Land Use Strategy is key here and there was strong support for promoting the Regional Land Use Partnerships as a vehicle for delivery, building on existing experience (e.g. through the LUS Pilots, National Park Authority, Tweed Forum type mechanisms). **Leadership and resource is required to establish new Regional Land Use Partnerships, and to sustain both new and existing partnerships. (Lead: Scottish Government through the LUS policies and proposals: http://www.gov.scot/Publications/2016/03/5773/4).**

(3) There must be a clear line of sight in policy documents on the application of the NEN; recognising, in particular, that both the Land Use Strategy and the National Planning Framework (next iteration '4') have a role to play as the NEN has a locus in urban environments as well as rural environments **(Lead: ALL - participants to take opportunities to input to planning reform and the development of NPF4 on this basis).**

(4) Financial incentives for land management need to be re-configured so that they better reflect good land stewardship and help support delivery of multiple benefits for many interests. Ideas are emerging on this from different sectors and there may be merit in having a round-table discussion to identify common ground and to find solutions to major areas of difference**. (Lead: SWT/Link - Susan Davies/Bruce Wilson/Daphne Vlastari – round-table group summer 2017)**.

[Continued on next page]

Priority Actions (continued):

(5) Improvements can be made to the way in which we share information, develop and apply mapping tools, raise awareness of existing initiatives and support exchange between landscape scale connectivity projects. There are existing portals and mechanisms which could be used for this and more work is required to scope the best delivery model(s). **(Lead: JHI - Alison Hester – follow up with Scottish Govt on LUS policies and proposals: Land Use Data Directory, SEWeb, etc, summer 2017).**

(6) Open data principles, and transdisciplinary approaches to analysis and assessment, need to be accepted as the norm. There seems to a clear business need for access to data collected and held by RPID through the IACS system and also land ownership information. A working group has been established within SG already to look at this issue and the group felt it was important to understand the Terms of Reference and to contribute views on operational needs **(Lead: - LLT – Harriet Donald to circulate more information)**.

(7) There is a developing knowledge and evidence base on which species benefit from corridors and which habitats could be improved by increasing connectivity (could be buffers, stepping stones, or corridors) - we need to build on this knowledge and its application with tools and outputs that can give spatial expression to the NEN through the **Regional Land Use Partnerships (Lead: SG proposals in LUS (see Action 2) and research institutions/funders)**.

(8) Important that more outreach is made to the land managing sectors (SLE, NFUS, sporting) to participate in the development of next steps on the NEN as they are so instrumental to helping build understanding about its purpose and securing its delivery **(Lead: SNH – links to action 1)**

(9) Progress with developing connectivity on the ground needs to be measured (links to action 5), and the Ecosystem Health Indicator – connectivity and Landscape scale partnership map could form the basis of this **(Leads for indicators: SNH – Pete Rawcliffe - in progress through SBS).**

References

Curran JC and Curran SA, 2016a. Indications of positive feedback in climate change due to a reduction in Northern Hemisphere biomass uptake of atmospheric carbon dioxide. *Weather*, 71, 88-91.

Curran JC and Curran SA. 2016b. An estimate of the climate change significance of the decline in the Northern Hemisphere's uptake of carbon dioxide in biomass. *Weather,* 71, 226-227.

Gimona A, Poggio L, Brown I, Castellazzi M 2012. Woodland networks in a changing climate: Threats from land use change. *Biological Conservation*, 149, 93-102.

Gimona A, Poggio L, Polhill G, Castellazzi M 2015. Land use intensification reduces networks effectiveness and increases disequilibrium between climate and species distribution. *Landscape Ecology*, 30, 771-789.

Haddad NM *et al*., 2015. Habitat fragmentation and its lasting impact on Earth's ecosystems. *Science Advances*, 1:e1500052.

Lawton JH, Brotherton PNM, Brown VK, *et al.* 2010. Making Space for Nature: a review of England's wildlife sites and ecological networks. *Report to Defra*.

Lindenmayer D, Hobbs RJ, Montague-Drake R, *et al*. 2008. A checklist for ecological management of landscapes for conservation. *Ecology Letters*, 11, 78-91.

Pew Research Center. 2014. Climate change seen as top global threat, Author: Jill Carle.

Annex 1 and 2

Annex 1 and 2 is a stand-alone document in the same format as this workshop report, entitled: **“Annex 1 and 2: presentations”**

It contains printouts of all the presentations as follows:

Annex 1. Connectivity in context – the need for a new approach. Keynote presentations

Annex 2. Short showcase talks – existing initiatives

"NATURE CONNECTIONS: working together to enhance Scotland's environment, biodiversity and resilience to climate change"

Contact: Alison Hester

alison.hester@hutton.ac.uk

tel. 01224 395196

James Hutton Institute
Craigiebuckler
Aberdeen AB15 8QH
Scotland
UK

Workshop photographs taken by Alison Hester and Scott Herrett. Landscape photo: Tarskavaig, taken by Alison Hester