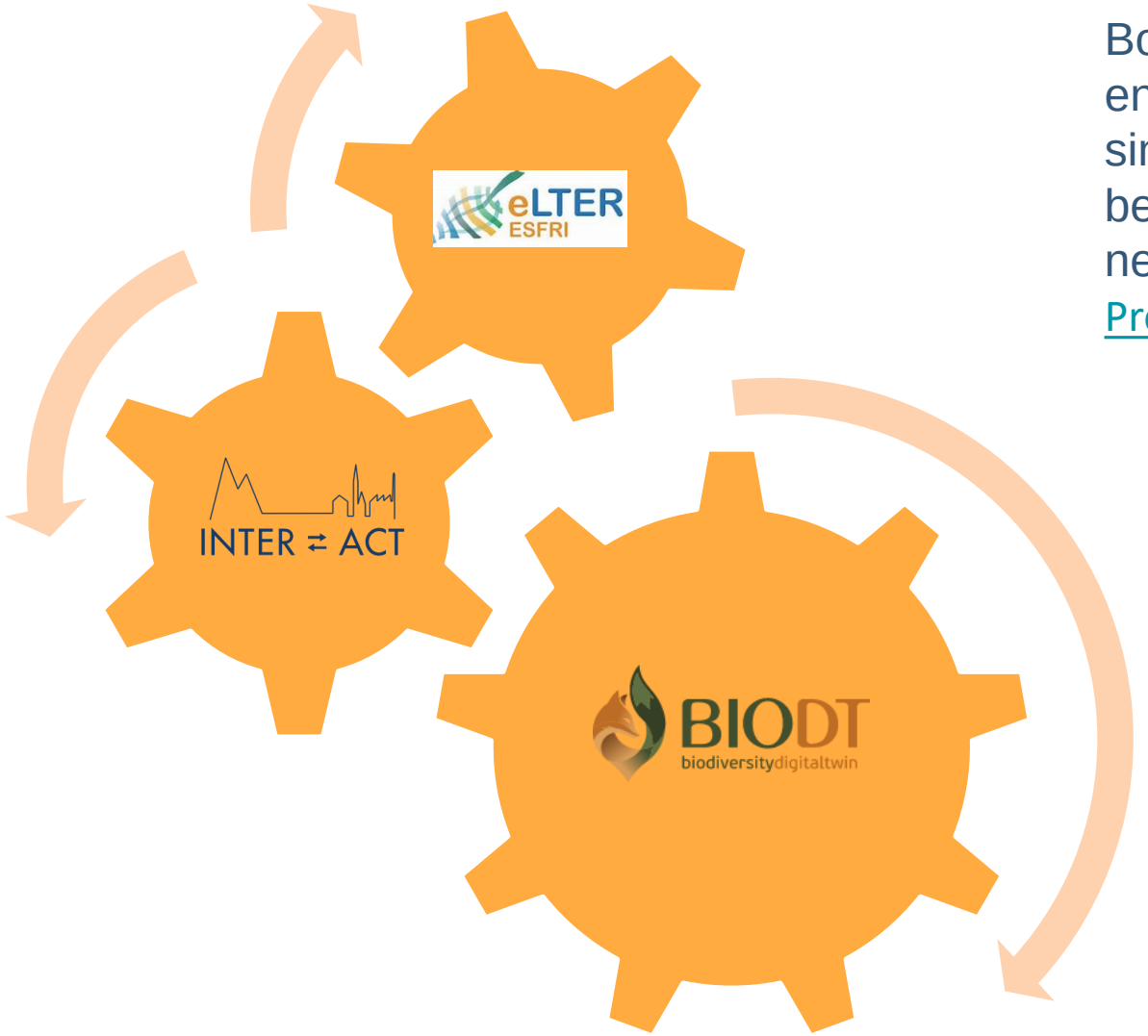
Acoustic Research in the Cairngorms – Using sound to measure questions of interests

Long-Term Ecosystem Research (LTER) seeks to improve our knowledge of the structure and functions of ecosystems and their long-term response to environmental, societal and economic drivers.
eLTER - Evolution & elements (elter-ri.eu)



Bottom-up artic and alpine environmental monitoring network since 2001 has expanded to become a true circumarctic network of terrestrial field stations
Project - INTERACT (eu-interact.org)

BioDT
The Biodiversity Digital Twin prototype provides advanced models for simulation and prediction capabilities, through practical use cases addressing critical issues related to global biodiversity dynamics.
https://biodt.eu

eLTER

Integrated European Long-term Ecosystem, critical zone and socio-ecological Research

Filling a critical gap for top-class science at the continental scale

Acoustic monitoring and eLTER

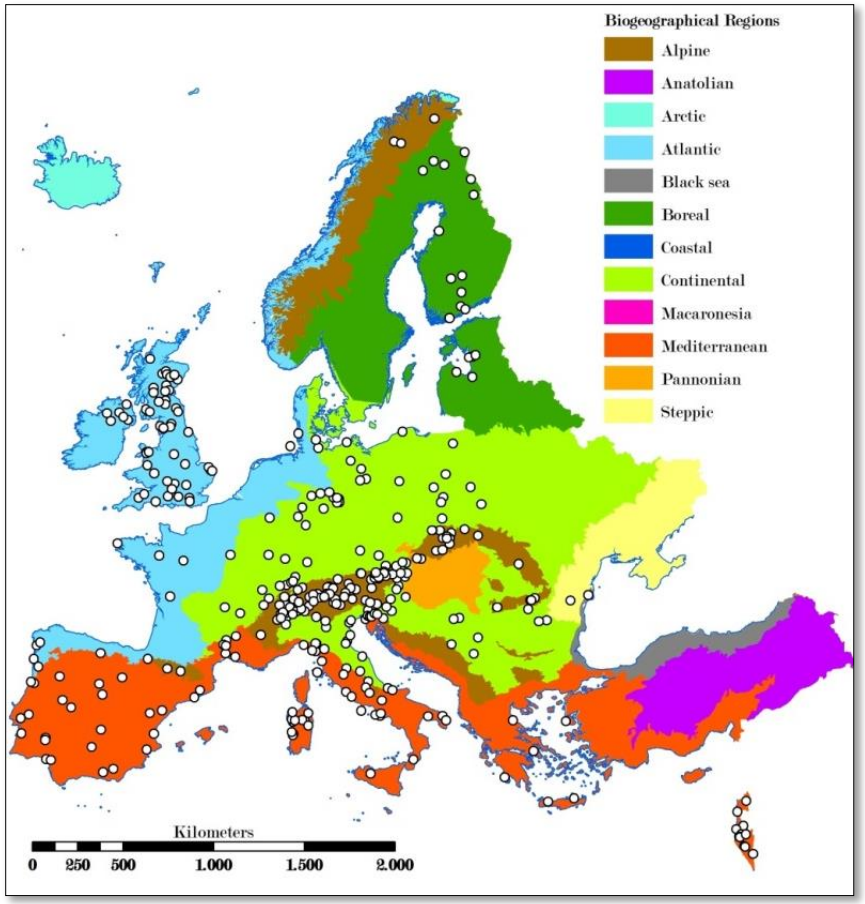
Jan Dick
Senior Social Ecologist
UKCEH, Edinburgh, Scotland

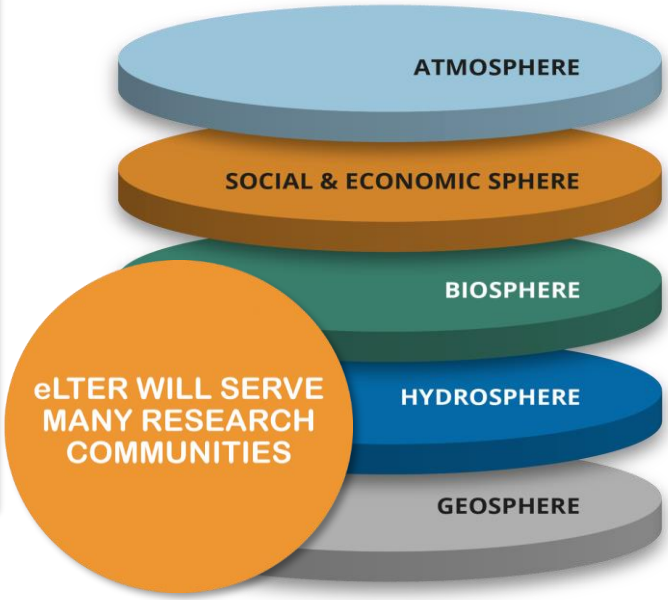
Chris Andrews
Environmental Change Network Site manager – Cairngorms
UKCEH, Edinburgh, Scotland

UK-SCAPE
UK Status, Change and Projections of the Environment

UK Centre for Ecology & Hydrology

“Whole System“-Approach: Cross-disciplinarity addressing the Life Supporting System





EnvEurope

eLTER H2020

27 national LTER networks

>550 sites & platforms

eLTER ESFRI

eLTER PLUS

4+10 Mio
35 beneficiaries
~250 experts

eLTER PPP

eLTER RI

~170 Research Organizations

18 (20) countries

Research Communities & ”eLTER network”

Continuous long-term operation of ~200 innovative hubs

eLTER

Workflow to create the network design for the RI

Variable

Which variables?

What do communities and countries think?

METHOD
(Method + Protocol)

Relation to site categories?

Which methods?

Feasibility

What are the costs?

Acceptable compromises?

Resulting overall network?

Cost-Efficiency

What are Ministries willing to pay?

Details of Standard Observations currently being determined: consultation Jan 2023

Sphere	Method	SO ID	Standard Observation	Based on	Interval of Measurements	Sensor (type) / Narrative or Quantitative	Range of sensors / samples per site		Proposed protocol
Biosphere	Prime	SOBIO_018	Birds, bats, frogs, insects using acoustic recording	sensor	1 month; 1 week	Audiomoth set for bats and all other taxa groups	1	10	Lifeplan
Biosphere	Basic	SOBIO_018	Birds, bats, frogs, insects using acoustic recording	sensor	3 month; 5 years	Audiomoth set for birds and other taxa groups but NOT for bats	1	1	Lifeplan

Acoustic monitoring of biodiversity but what about humans

eLTER

INTER⇌ACT

Task 2.6 The Arctic Resort (Lead: UKCEH)

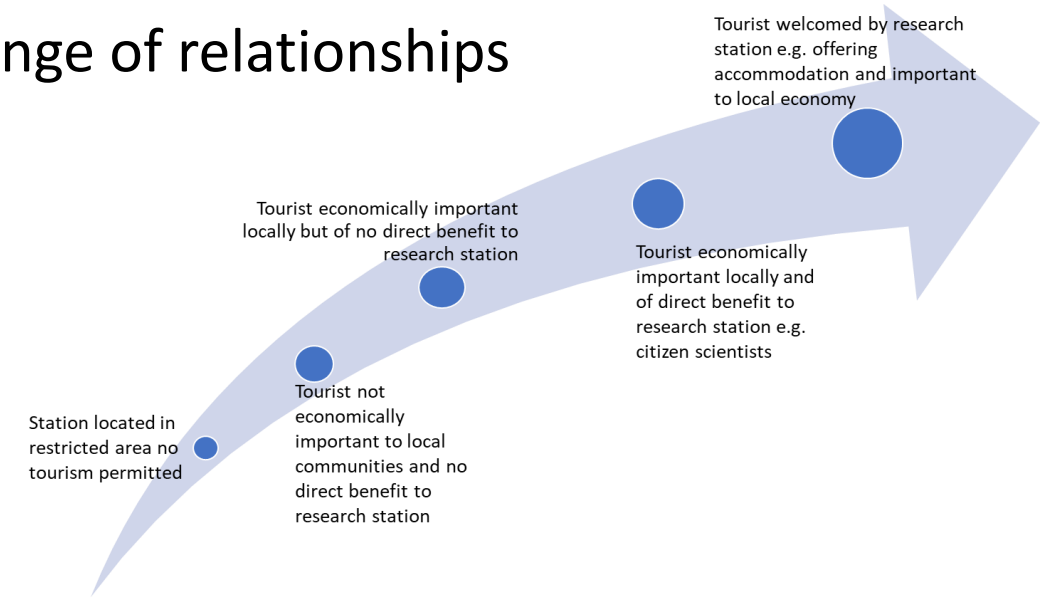
www.eu-interact.org

HORIZON 2020

By Jan Dick, Chris Andrews, Elmer Topp-Jørgensen, Susse Wegeberg

And all those who contributed to the deliverables

Range of relationships



Cooperative

Economic benefit

Contribute to the science

Awareness raising and education

Conflict

Physical interference with equipment or nature

Source of contaminants biological or man-made

Positive themes

Economic

- Accommodation fee
- Educational tours
- Purchasing merchandise

Research

- Contributing data to citizen science programs
- As research subjects

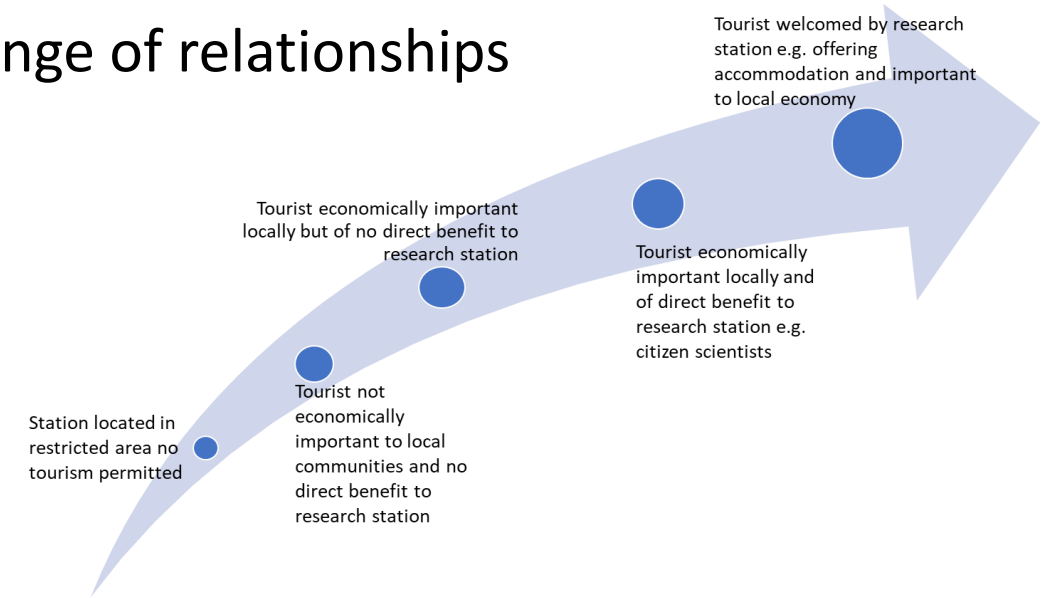
Public outreach

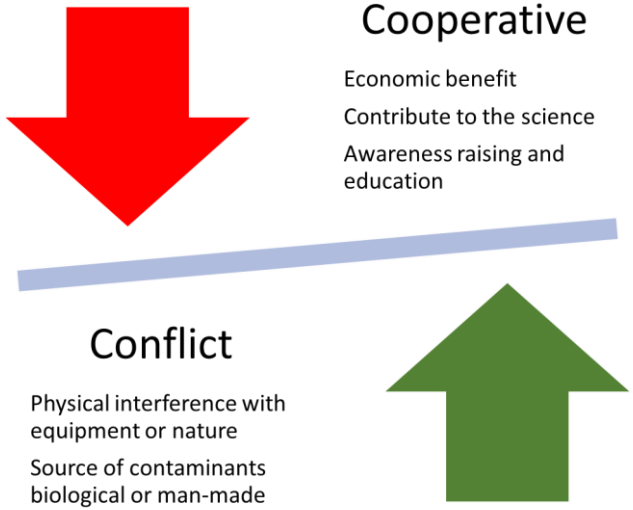
- Attending Open Days

Negative themes

Environmental compartment monitored	Types of potential impacts from tourism
Vegetation	Physical interference with equipment and monitoring plots.
	Human or vehicle tracks resulting in erosion.
	Spread of alien species.
	Vegetation-animal interaction, e.g., disturbing natural grazing, seed dispersal, etc.
	Contamination with human waste products.
Air	Physical interference with equipment.
	Human source of contamination, e.g., carbon dioxide from human breath.
	Vehicle/machinery sources of contamination, e.g., NOx gases from vehicle exhausts.
Water	Physical interference with equipment.
	Human sources of contamination, e.g., biological waste.
	Vehicle/machinery sources of contamination, e.g., oil.
	Great demands on local water sources, particularly in dryer areas.
	Physical interference with waterways.
Biodiversity	Physical interference with equipment, e.g., camera traps, acoustic recorders.
	Presence of humans disturbing animal behaviour.
	Vehicle/machinery disturbance to animal behaviour.
	Light pollution disturbing animal behaviour, e.g., moth traps.
	Noise pollution disturbing animal behaviour, e.g., shy nocturnal animals.
	Drones disturbing animal behaviour.
	Extraction of biological resources (berries, mushrooms, fish etc.).
Local communities	Disrespect towards local communities by, e.g., taking photos of children and local culture.
	Disrespect towards local communities' property, e.g., walking across crops and disturbing livestock.

Range of relationships





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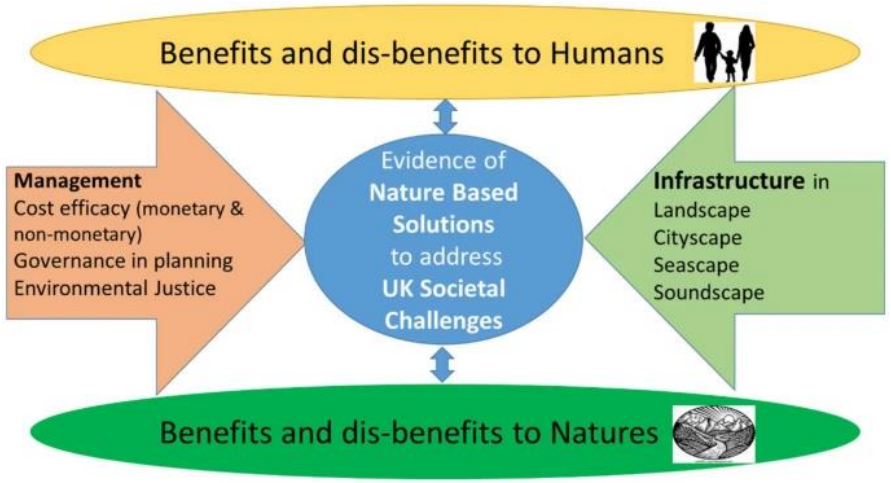
Soundscape, Nature based solutions and human well being



	Ecosystem restoration approaches-focus on nature		Ecosystem-related approaches focus on humans		Infrastructure-related approaches				Ecosystem-based management approaches			Ecosystem protection approaches	
	Ecological restoration	Ecological engineering	Adaptation	Mitigation	Natural	Green engineered	Blue engineered	Mixed	Integrated landscapes	Integrated coastal zone	Integrated water resources	Area based conservation	
Economic living standards					1	6	3	3					HWB1
Material living standards						3	1					1	HWB2
Health					3	8	3	3					HWB3
Education					1	4	3	2					HWB4
Social relations													HWB5
Security and safety					1	1	1	1					HWB6
Governance and empowerment													HWB7
Subjective well being					5	8		1	1			2	HWB8
Culture and spirituality					1	1		1	1			1	HWB9
Freedom of choice and action													HWB10
	NBS01	NBS02	NBS03	NBS04	NBS05	NBS06	NBS07	NBS08	NBS09	NBS10	NBS11	NBS12	

Heatmap illustrating the distribution and frequency of occurrences of evidence from studies reporting on positive or negative aspects of the **acoustic environment** related to NBS actions/interventions on HWB

Dick et al (2019, 2020) concluded that the soundscape was the least studied of the societal challenges identified by policy makers following a systematic literature review of nature-based solutions and human wellbeing linkages.

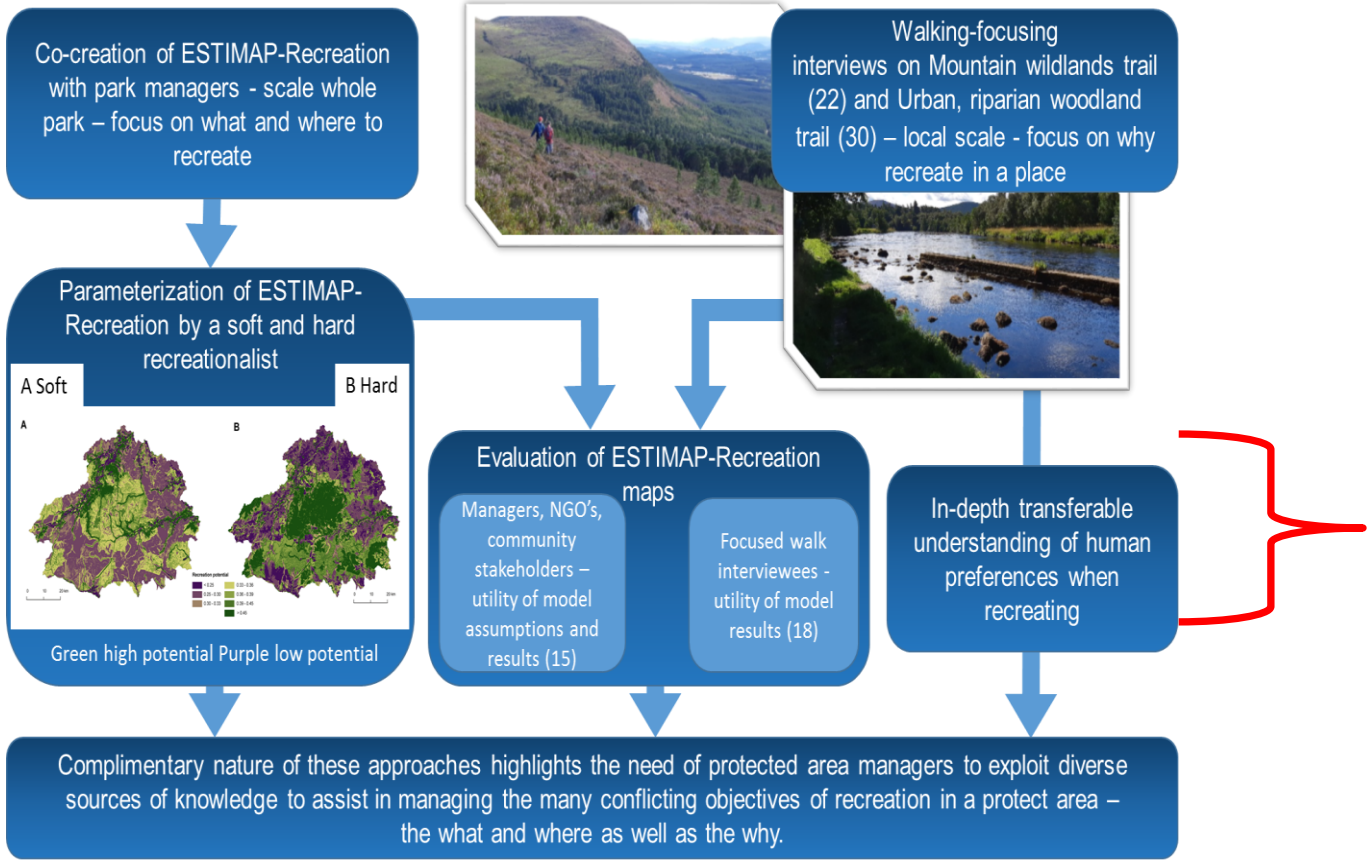
	Ecosystem restoration approaches-focus on nature		Ecosystem-related approaches focus on humans		Infrastructure-related approaches				Ecosystem-based management approaches			Ecosystem protection approaches	
	Ecological restoration	Ecological engineering	Adaptation	Mitigation	Natural	Green engineered	Blue engineered	Mixed	Integrated landscapes	Integrated coastal zone	Integrated water resources	Area based conservation	
Economic living standards		2		1	12	29	12	12	4		1	1	HWB1
Material living standards		2		1	7	29	1	12	3		1	2	HWB2
Health	1	1		2	28	53	13	19	3			1	HWB3
Education					6	16	8	7	1				HWB4
Social relations					5	12	5	4	1				HWB5
Security and safety	1				5	1	5	4					HWB6
Governance and empowerment		1			1	19	4	7	2				HWB7
Subjective well being	2				22	36	7	7	3			2	HWB8
Culture and spirituality		1			9	7	3	8	5			2	HWB9
Freedom of choice and action													HWB10
	NBS01	NBS02	NBS03	NBS04	NBS05	NBS06	NBS07	NBS08	NBS09	NBS10	NBS11	NBS12	

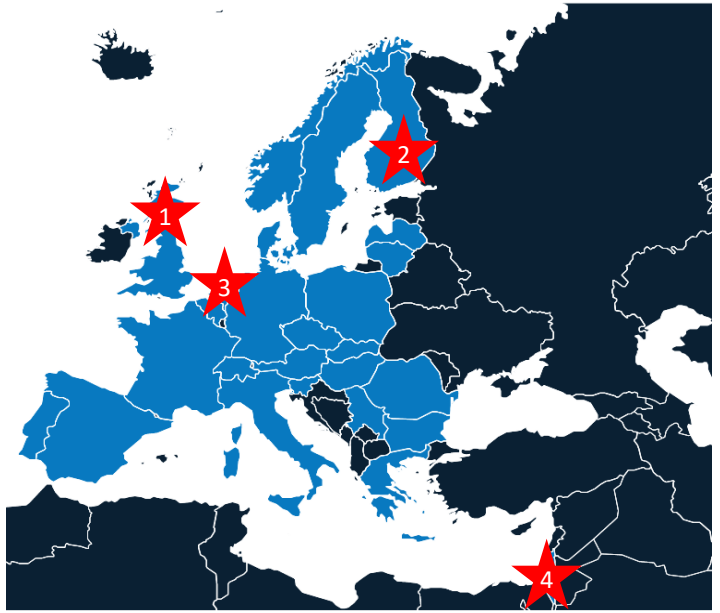
Heatmap highlighting linkages between NBS actions or interventions and HWB outcomes associated with **all focal societal challenges**

Dick, J., Carruthers-Jones, J., Carver, S., Dobel, A., Miller, J.D. (2020). How are nature-based solutions contributing to priority societal challenges surrounding human well-being in the United Kingdom: a systematic map. Environmental Evidence, 9, 25. https://doi.org/10.1186/s13750-020-00208-6

115 studies included in the systematic map database

Combining network and local studies





What we did at the network scale

- We conducted in-depth on-site walking interviews in four ILTER sites

What we did at the local scale

- We implemented a spatially-explicit recreation model & tested its utility with stakeholders
- We investigated other cultural ecosystem services through in-depth on-site interviews
- We discussed utility of results with park mangers

INTER ⇄ ACT

eLTER

Four contrasting sites

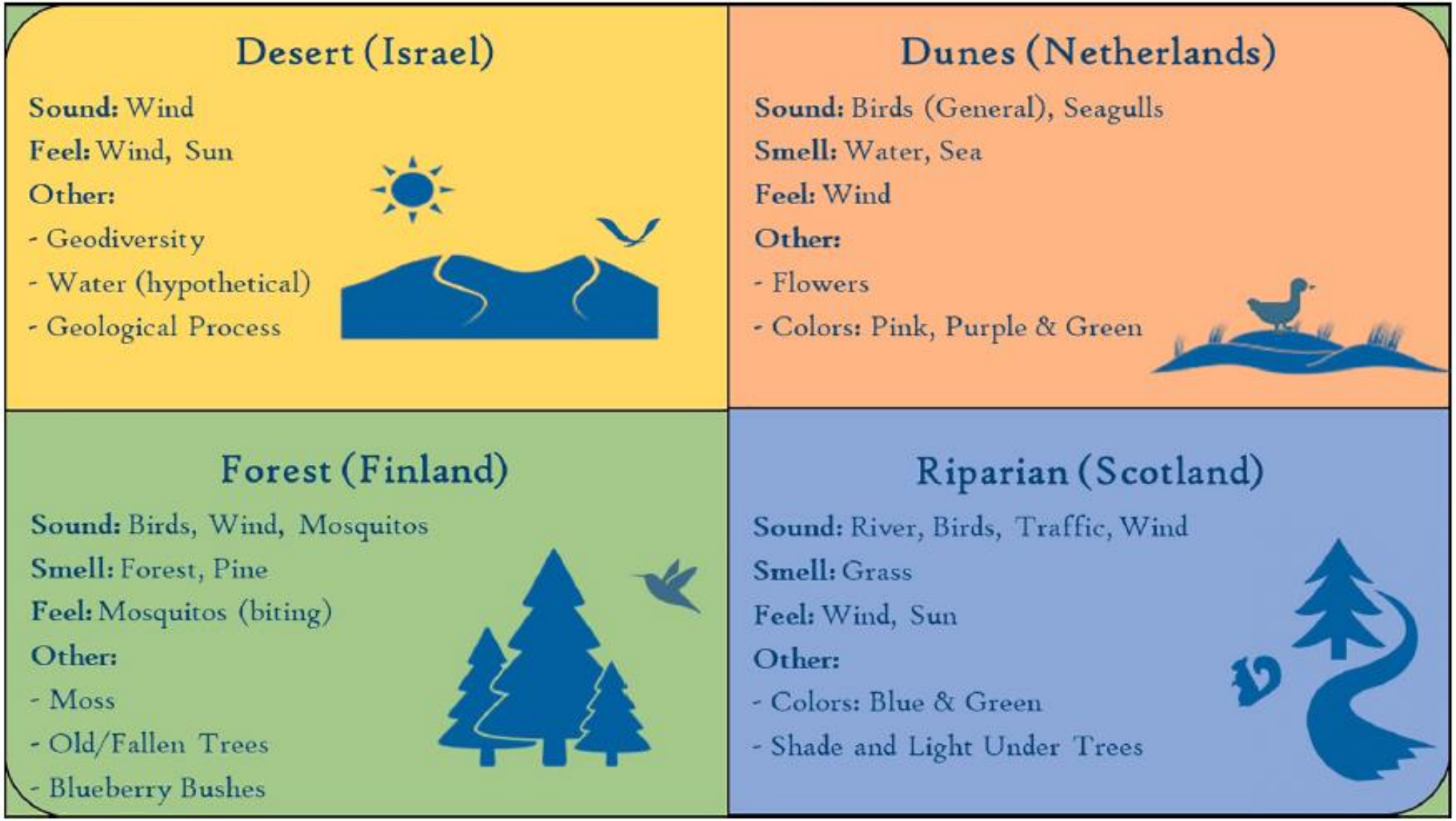
Riparian:
Cairngorms National Park Scotland

Dunes:
Dunes National Park, Texel, Netherlands

Forest
Seitseminen National Park, Finland

Desert
Bor Hemet Reserve, Negev Desert, Israel

Yael Teff-Seker interviewing on the “Mountain wildlands” trail



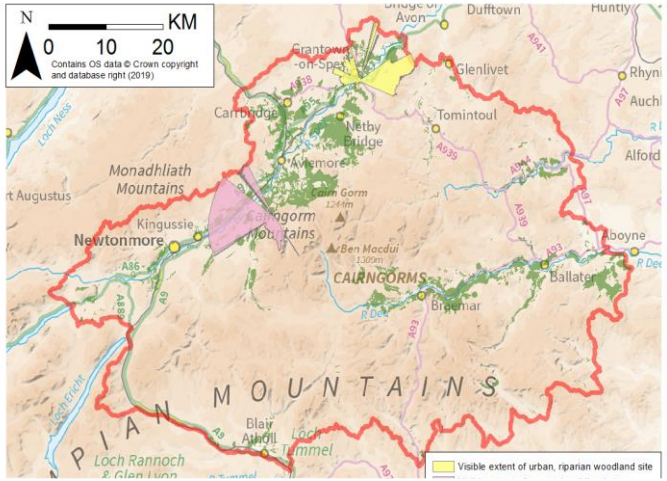
Teff-Seker, Y, Rasilo, T, Dick, J, Goldsborough, D, Orenstein, DE 2022 What does nature feel like? Using embodied walking interviews to discover cultural ecosystem services Ecosystem Services 55
http://dx.doi.org/10.1016/j.ecoser.2022.101425

Can acoustic monitoring help us understand human appreciation of landscapes?

Urban riparian woodland(yellow)

Mountain wildlands (**pink**)

Themes	% Participants mentioning theme	
	"Urban, riparian woodland" trail (n=30)	"Mountain wildlands" trail % (n=22)
Sound: River/Stream	77%	50%
Sound: Birds	57%	50%
Sound: Wind	37%	45%
Sound: Quiet	10%	32%
Sound: Wind through the trees	33%	-
Sound: Traffic (negative)	63%	9%



Two focal walks: yellow and pink areas highlight the visual extent of the view (limited to 10km) from the *Urban riparian woodland(yellow)* and *Mountain wildlands* (**pink**) trails, respectively

Dick, J., Andrews, C., Orenstein, D., Teff-Seker, Y. and Zulian, G. 2022 A mixed-methods approach to analyse recreational values and implications for management of protected areas: a case study of Cairngorms National Park, UK. Ecosystem Services 56 http://dx.doi.org/10.1016/j.ecoser.2022.101460

An overview

BIODT
biodiversitydigitaltwin

A digital twin linking recreational potential and biodiversity in the Cairngorms National Park

Funded by the European Union

Jan Dick, Chris Andrews, Simon Rolph, John Watkins - UKCEH

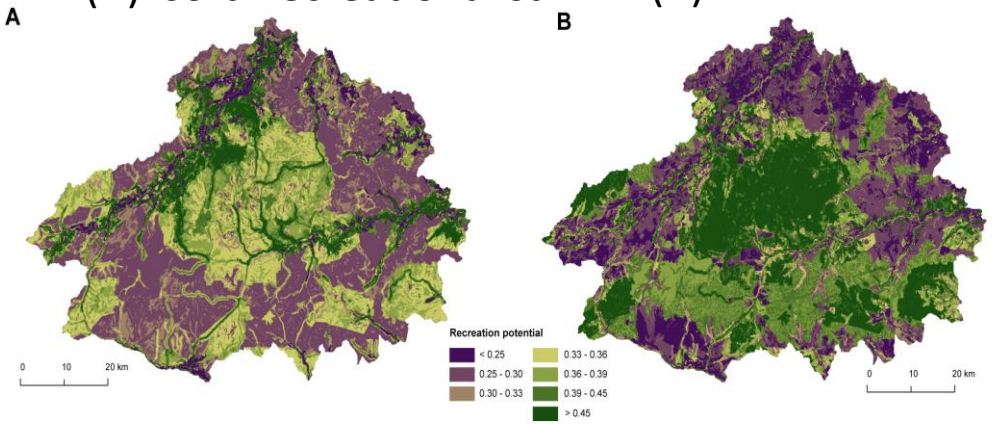
Background

- Biodiversity is recognised as a key ecosystem service in all branches of ecosystem service research but of particular importance in relation to the cultural ecosystem services
- A recreational model for the Cairngorms National Park exists but does not link to models of biodiversity

Recreation model

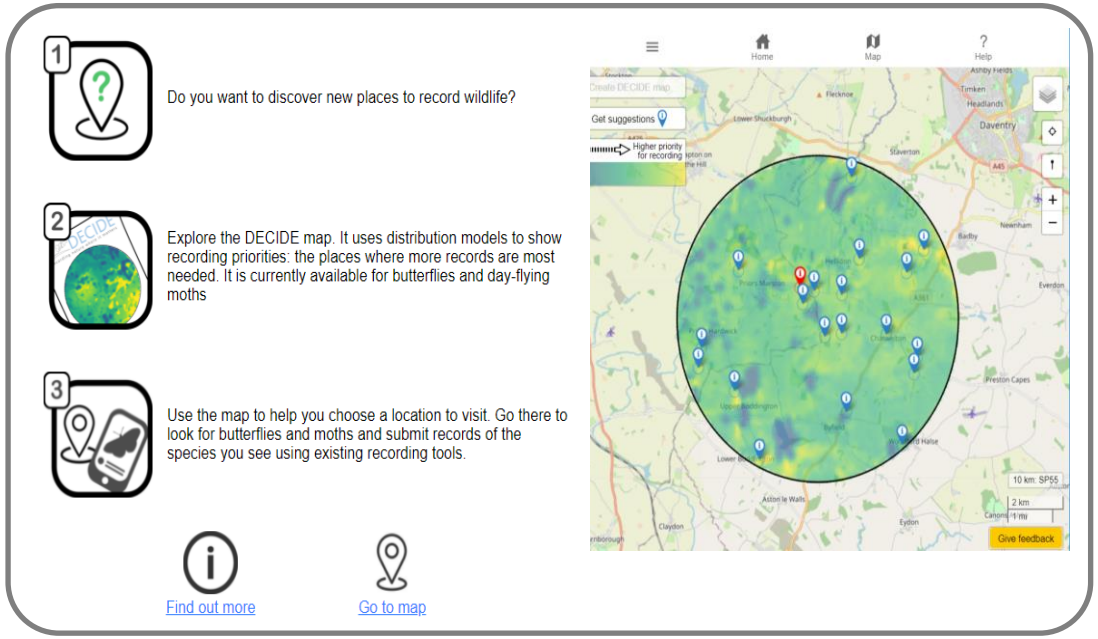
(A) ‘soft’ recreationalist

(B) ‘hard’ recreationalist



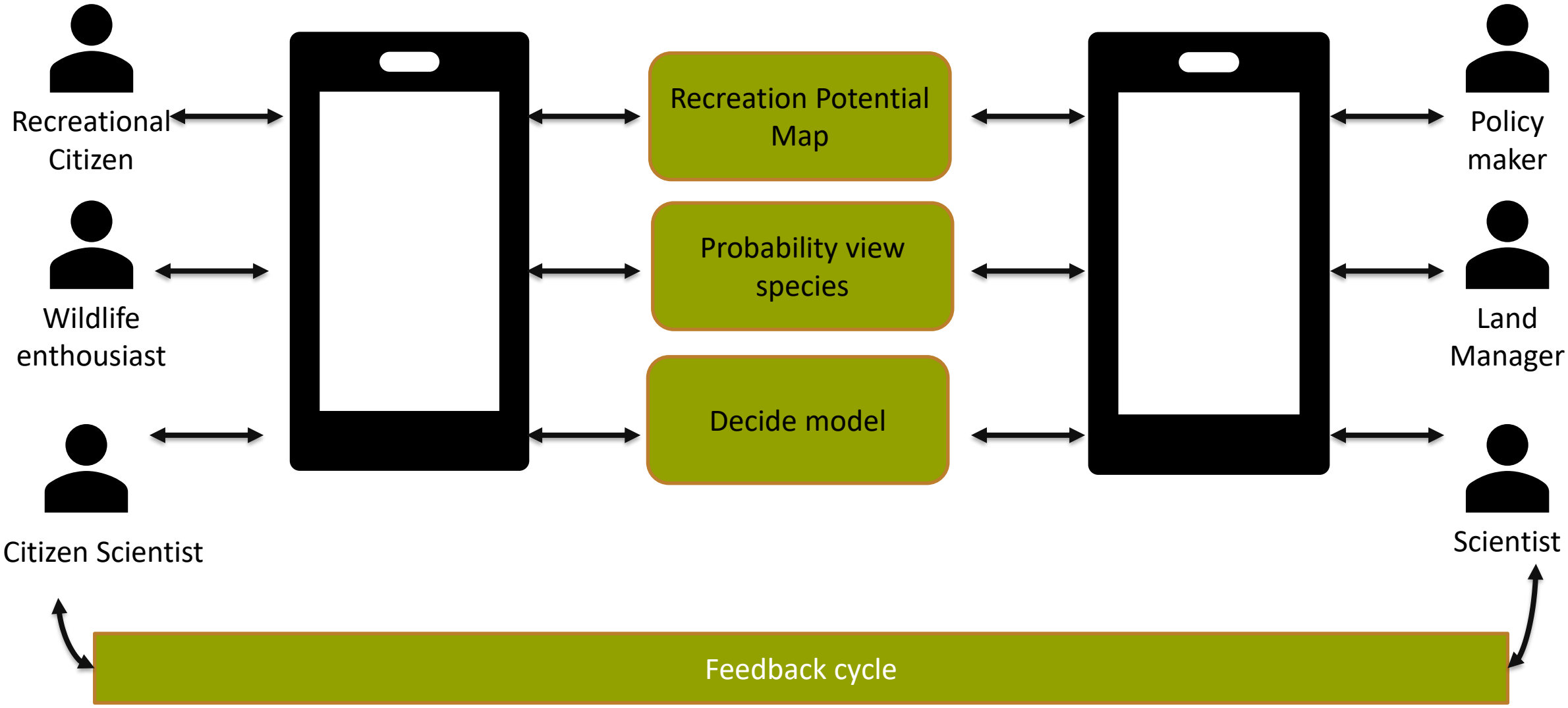
Zulian, G. et al, 2018. The practical application of spatial ecosystem service models to aid management of nature-based resources. Ecosyst. Serv. 29 (Part C):465-480

The DECIDE Tool



https://decide.ceh.ac.uk/

Different stakeholders/users



A work in progress

Using sound to measure questions of interests

BIODT
biodiversitydigitaltwin

@BiodiversityDT

BioDT

Funded by
the European Union

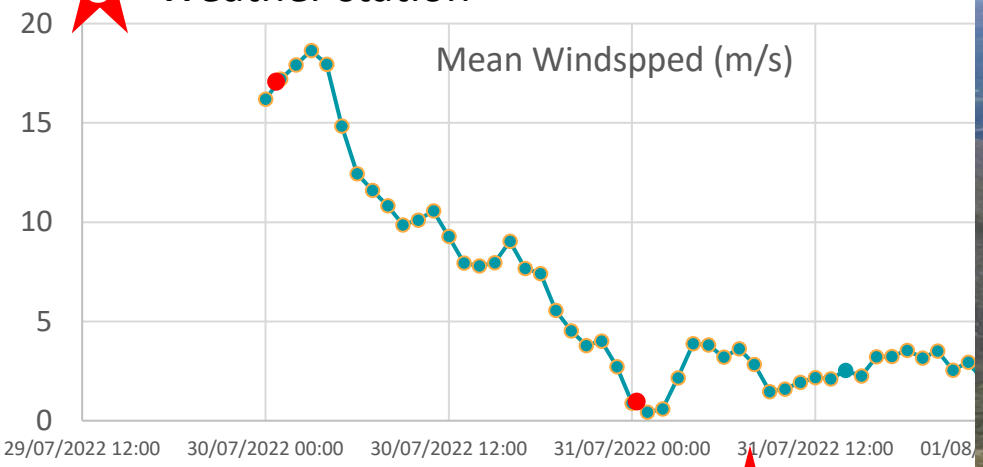
Soundscape from two habitats will be tested in the digital twin

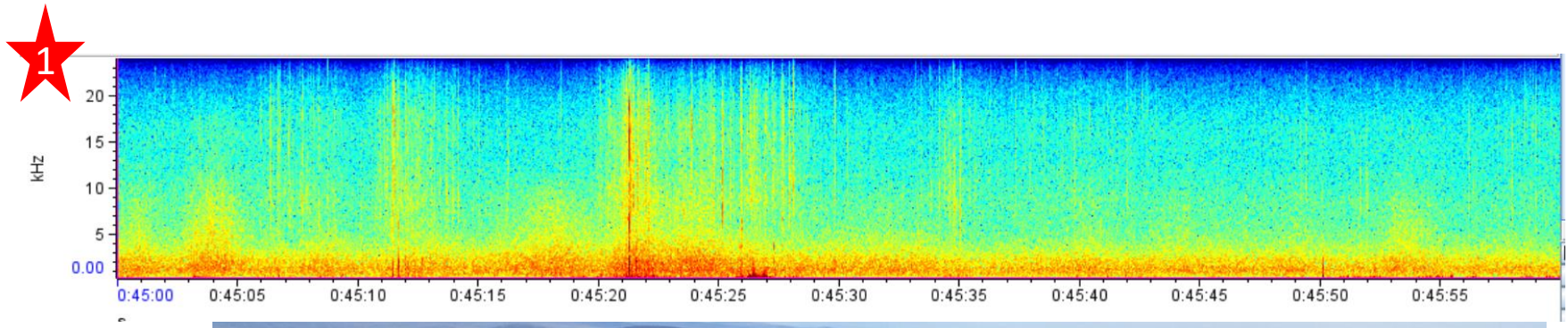
Soundscape – wind and rain

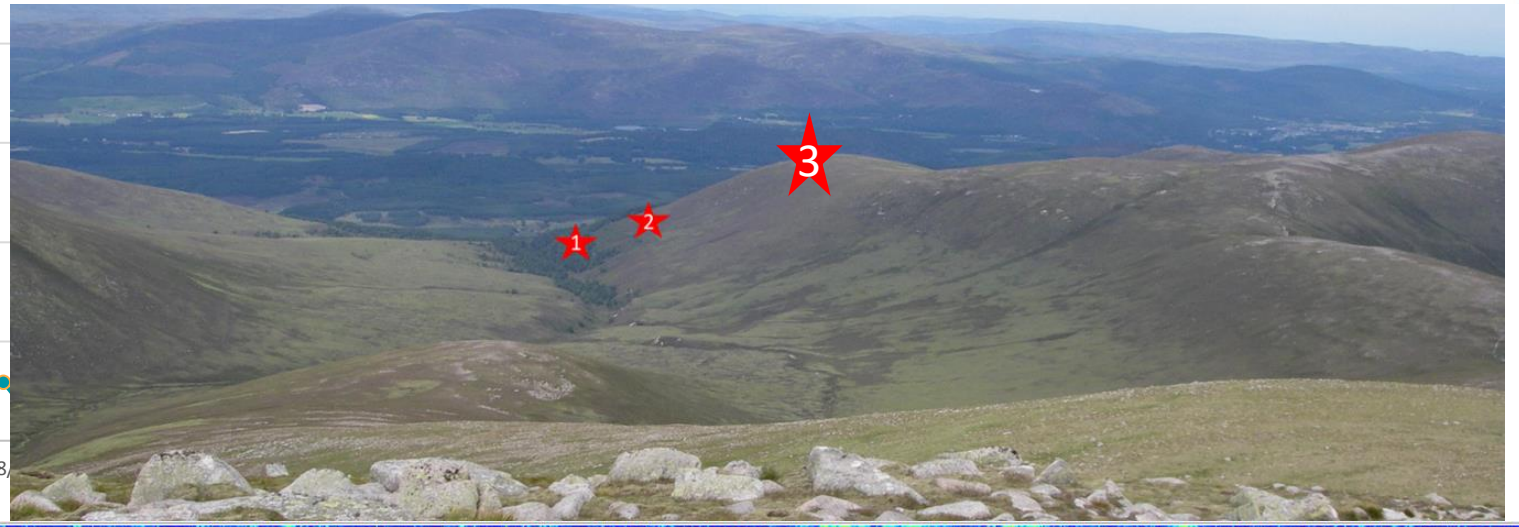
1 Woodland

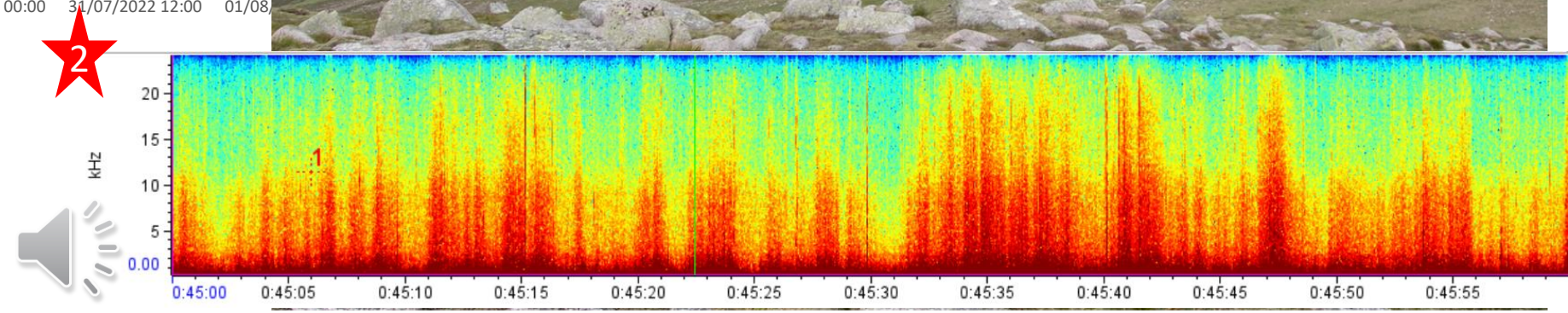
2 Moorland

3 Weather station







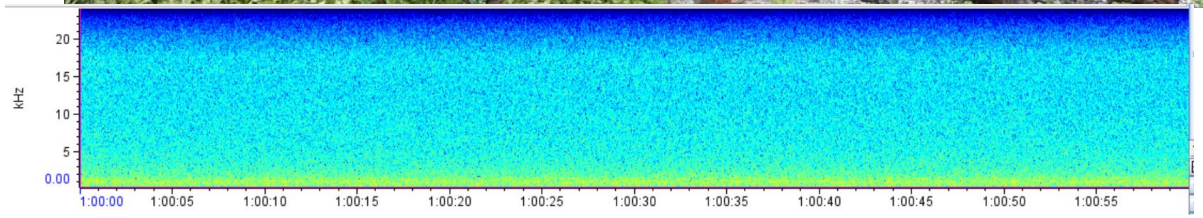


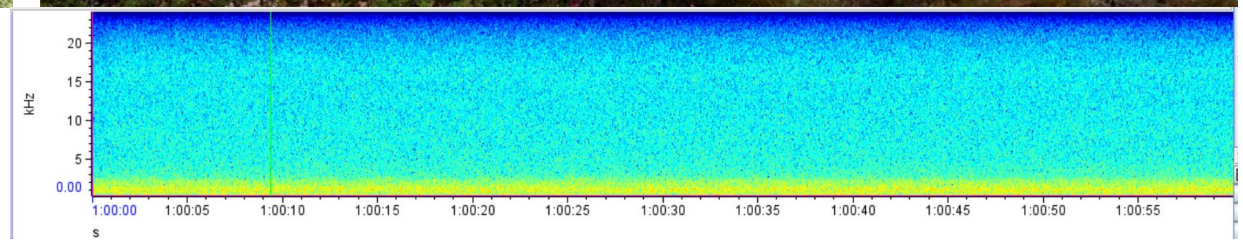
Date Time	Rain fall (mm)	Mean windspeed (m/s)	Max windspeed (m/s)
30/07/2022 00:00	0	16.2	22.26
30/07/2022 01:00	1.224	17.21	22.26
31/07/2022 00:00	0	0.882	2.94
31/07/2022 01:00	0	0.427	1.26

30 July 2022 00:45 blowing rain

1 min every 15min

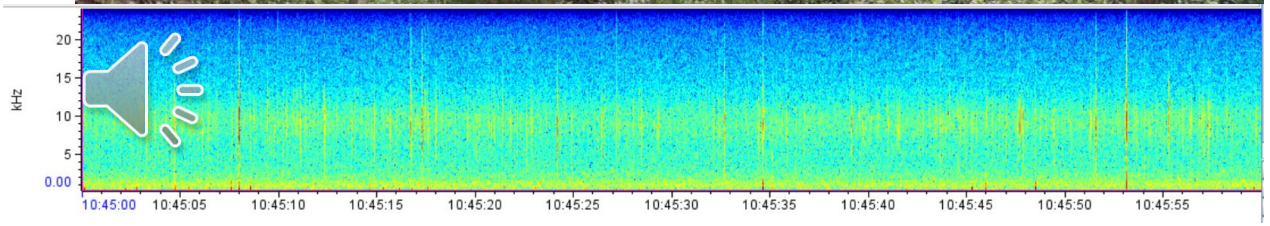
Soundscape – quiet

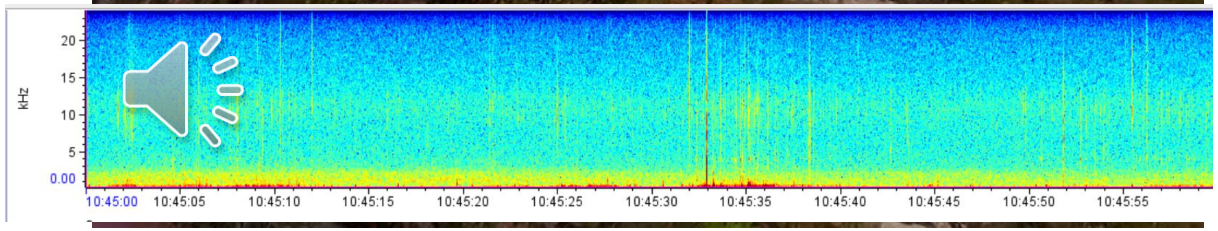


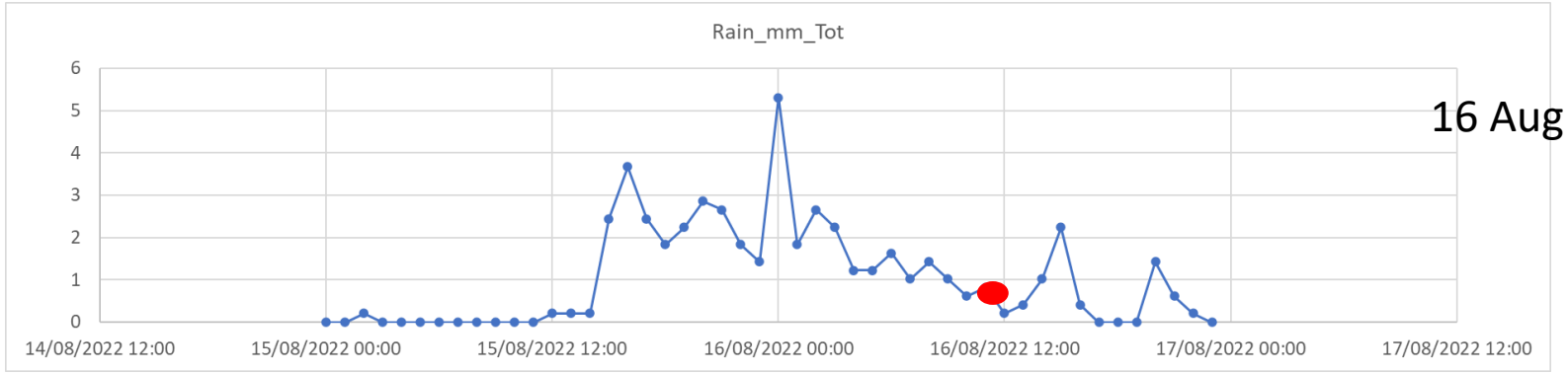


31/07/2022 01:00 Mean wind speed 0.427 m/s; Max wind speed 1.26 m/s 0mm rainfall

Soundscape – rain drops







16 Aug 2022 10:45 Raining for nearly 24 hrs
Wind speed 5.5 m/s
Max Gust 7.9 m/s


BIODT
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@BiodiversityDT
BioDT
Funded by
the European Union