Appendix 1. Identified evaluation steps in major ecological restoration projects in the northern hemisphere.

Habitat restored and objectives	Identity of restoration project	Step 1 Within planning	Step 2 Between planning and implementation	Step 3 Within implementation	Step 4 Between implementation and monitoring	Step 5 Within monitoring	Step 6 Between monitoring and planning	References
Alpine heathland: removal of roads, military infrastructure, explosives and pollutants, restoring landscape structures and vegetation	Dovre Mountain, Norway	Interaction between Norwegian Defence Estates Agency (NDEA) and experts during the initial planning process resulting in more specific plans	NDEA planned and operated the project, and met with authorities, municipalities, tourist companies and hunters. NDEA evaluated the implementation and the outcome was used for further planning of subsequent project phases	Methods based on previous experiences. Collaboration between the project owner, ecologists and contractors led to some modification of procedures and logistic adjustment for large-scale application	Monitoring results reported back to people responsible for the implementation (ecologists, machine drivers, project owner) resulting in minor modifications and adjustments on site	Monitoring established as a pilot project 4 years before restoration. Vegetation data gave feedback on restoration methods (in particular the use of turfs, seeds and fertilizer). Data integrated into steps 3 and 4	The project owner posted annual reports on the web and distributed newsletters. Scientists reported on websites and conferences. Modifications were proposed to project owner. The cooperation procedure applied to related projects, e.g., hydropower and road construction	Martinsen and Hagen 2010, Hagen and Evju 2013, Forsvarsbygg 2015
Alpine heathland: removal of structures on a former mine site	Nalunaq gold mine, Greenland	Evaluation of clean-up and restoration plans between the mining company and central authorities	Stakeholder meetings and public hearings processing original and revised documents. The Environmental Impact Assessment was revised when production procedures were changed after 2009	It was decided not to use non-native seeds or plants to avoid unnatural conditions and invasive plants; therefore only barren land was left to be colonized by local plants	Informal but good communication and support were supplied to the monitoring team from the mining staff at Nalunaq	Ten monitoring reports produced, evaluating elements in aquatic and terrestrial environments. Monitoring will continue at least 3 years after the closure and was planned to take place during 2014–2016	Monitoring program evaluated and changed due to changes in mining techniques, i.e., emphasizing cyanide after 2009. Based on monitoring results it was possible to change demands towards the mining company	Dominy et al. 2006, Bell and Kolb 2013
Birch woodland: reforestation to enhance resilience to ash deposition	Hekluskógar, Iceland	Meetings with farmers and other stakeholders, presenting project ideas. Some areas excluded from the project due to farmers' concern about continued use of grazing commons	Project implementation discussed in a stakeholder group and with a wider audience, resulting in amendments of plans	Internal follow-up of implementation, mostly regarding planting of seedlings by contractors and landowners and other practicalities. This often led to adjustments of implementation	Landowners, contractors and other practitioners reported planting and revegetation activities to project manager. Monitoring results provided feedback to implementation	Original plans included regular monitoring of ecosystem development and assessment of socio-economic impact. Lack of funding restricted monitoring to seedling survival	Simple annual reports posted on project website, and project information reported at conferences together with monitoring results. Plans adapted based on monitoring results if needed	Aradottir 2007, Óskarsson 2009 a, b, 2011, Berglund et al. 2013, Hunziker et al. 2014. Hekluskógar 2015.
Rangeland:	Farmers Heal the	Interaction between	SCSI district officers	Individual farmers	During annual or	The annual, subjective	Next year's work	Schmidt 2000,

revegetating eroded areas by adding seeds, fertilizer and mulch	Land, Iceland	the Soil Conservation Service of Iceland (SCSI) and farmers during the initial planning process resulting in an adjusted approach	discussed and adjusted restoration plans based on farmers' feedback. SCSI district officers also evaluated whether activities were implemented as planned	adjusted their methods when needed due to practical restrictions. SCSI district officers and farmers discussed and sometimes modified methods	biannual visits farmers informed SCSI district officers about their restoration interventions, making revisions of subsequent interventions possible	assessment is informal and limited documentation is produced. This has been identified as too weak, and currently objective evaluation methods are being developed and tested	based on outcome of assessment. Results of questionnaires and informal interviews with participants have influenced project management	Elmarsdottir et al. 2003, Arnalds 2005, Berglund et al. 2013, Petursdottir et al. 2013a, b
Forest: burning, storm simulation, and cutting or wounding trees	Green Belt LIFE, Finland	Plans adapted after field conditions and research needs. Impact of reindeer grazing on plant regeneration included in the planning	Planners, practitioners and scientists discussed practicalities. Meetings for local people informed about restoration. Fire brigades and border patrols were informed about burnings. Technical evaluation carried out according to EU-LIFE standards	Established restoration methods applied by the coordinator and the researchers. Burning needed instant evaluation as it depends on weather conditions and could be implemented only during a short time frame	Location of monitoring gear conveyed to practitioners to avoid damage during implementation. For practical reasons, such as space requirements for burning, or mistakes made by the harvester in the tree cutting sites, control and restoration monitoring sites had sometimes to be moved	Different variables measured in different years, e.g., burning impact on trees not seen until after several years, but for the ground it was the opposite. Monitoring focused on species thought to respond to restoration. Research plots established to monitor new mineral soil patches after storm simulation	Scientists made results available through meetings, seminars, and discussions in the Finnish Restoration Board. Modifications proposed by scientists could not be applied to this project, but have been considered for later restoration projects	Similä and Junninen 2012; Hekkala et al. 2014a, b
Grassland: decreasing cover of invasive plants and reintroducing native species	Northern Great Plains, Canada	Interested landowners or government agencies were chosen as partners. Funds including evaluation were raised	Planners and practitioners discussed feasibility of plans with respect to site accessibility, required personnel, and available machines and methods	Methods were adjusted based on field experience, e.g., increasing soil–seed contact by removing extant vegetation improved the outcome of restoration	This step provided a chance to add variables based on field work, e.g., incorporate later ideas about nutrients or soil water by measuring their availabilities	Unexpected responses could be incorporated, e.g., counting flowering individuals of prominent target species	Discussion with stakeholders at special seminars and other practitioners at more general restoration conferences	Heidinga and Wilson 2002, Ambrose and Wilson 2003, Bakker et al. 2003, Wilson and Pärtel 2003, Bakker and Wilson 2004, Wilson et al. 2004, MacDougall et al. 2008, Wilson and Pinno 2013
Montane grassland: removal or reduction in grazing to favor grass cover and stop erosion	Trotternish, Skye, Scotland	Interaction between the Scottish Government, landowners and scientists during the initial planning process resulted in adjustments of	Planners and landowners discussed the restoration plan. Input from farmers determined location and maintenance of fences	Methods involved two types of fences, excluding sheep and rabbits or just sheep. The project was like a trial, and monitoring was evaluated, but not	Information about exclosures, treatments, sheep numbers and control plots were communicated to the monitoring team	Vegetation found to be slow to recover (11 years), so monitoring project was extended by six more years	Results made available to Scottish Natural Heritage. Possible influence of climate change and social economic changes with reduction in sheep due to aging of	Hewison et al. 2016

		approach		implementation			crofters and changes in agri-environmental schemes	
Peatland: removal of redundant trees and blocking of ditches	Green Belt LIFE, Finland	Plans adapted to site conditions and, as far as possible, to research needs	Planners, practitioners and scientists discussed project practicalities. Meetings with local people informed about restoration actions. Technical evaluation carried out according to EU-LIFE standards	Established restoration methods applied by the coordinating organization. Whole tree cutting introduced and carried out by the researchers interested in the method	Location of groundwater wells for monitoring purposes conveyed to practitioners to avoid damage during tree harvest, blocking of ditches and placement of logging residue during project implementation	Monitoring established to respond to spatial questions in future even though there was no spatial expert in the monitoring group. New research plots established in restored ditches, as they served as new habitat types not existing before restoration	Scientists made results available through meetings, seminars and discussions in the Finnish Restoration Board. Modifications discussed for later projects. Practical reasons hindered whole-tree harvesting although monitoring indicated it to be more effective than current stem harvest	Laine et al. 2011, Tarvainen et al. 2013, Similä and Aapala 2014
Peatland: blocking of ditches	Caithness and Sutherland, Scotland	Landowners, scientists and conservationists collaborated to agree on plans and find funding sources. During preparation of a management strategy, also practitioners were involved	Planners and landowners discussed location and extent of restoration sites, restoration methods, and potential impacts of water level rise. Restoration plan changed when needed	No formal but probably unconscious evaluation during implementation, e.g., to check if drains were successfully blocked	Information of what drains were blocked where and what management was carried out was compared to original plans and communicated to monitoring teams	Evaluation mainly done post restoration	Lack of long-term monitoring and lack of baseline data were major concerns	Lunt et al. 2010, Life peatlands project 2015t
River: removal of channelization structures and meadow drainage	Skjern River, Denmark	Landowners, NGOs and a stakeholder advisory committee were involved. Modifications were made, e.g., it was decided not to lead the river flow through a lake to protect migrating salmon and trout from predatory pike	An Environmental Impact Assessment was made and a construction law was adapted in Parliament. Public hearings gave input to work description, including technical evaluation. The advisory committee gave input and minor modifications were made	Tenders were requested in two steps, making changes possible in the second step. A soil movement program was modified and a planned lake was enlarged. Artificial grass mixtures were seeded to increase grass productivity and promote domestic cattle grazing contracts	A short term monitoring program began right after the construction work. Any important changes compared to the original plans are not known	Monitoring began right after construction works. Monitoring programs and assessments were set-up to evaluate project outcomes. A LIFE project aiming at improving the grassland-habitats was initiated. This could not be fully accomplished due to some areas being too wet. EU accepted this deviation	Monitoring, surveys and analyses led to scientific papers on project outcomes. Project boundaries adjusted due to wetness in nearby land and landowners compensated. Grazing strategies modified. Parts of project area set aside for open-ended succession. Conflicts among stakeholders continually addressed	Pedersen et al. 2007a, b, 2010, 2014, Feld et al. 2011

River: removal of timber-floating structures, creation of fish spawning beds and diversification of channel morphology	Vindel River LIFE, Sweden	Restoration plans adapted to landowner reactions: planners started working with the most cooperative ones, leaving recalcitrant landowners to later	Planners and practitioners discussed plans with respect to site accessibility, personnel, machines and methods. Plans presented for landowners. Technical evaluation carried out according to EU-LIFE standards	Methods developed over years, e.g., methods for applying coarse sediment and large wood into channels and for constructing fish spawning beds. Methods modified based on gained insights Discussions in the field with contractors, planners and scientists	Practitioners updated scientists on performed actions to facilitate monitoring. Scientists proposed modifications to implementation, e.g., that available sediment was not coarse enough for recreating channel structures	Fish populations and riparian vegetation monitored. Biotic responses found to be slow or absent. Biotic monitoring methods modified and extended to account for this slow response	Scientists made results available through websites and conference presentations. Modifications proposed by scientists to practitioners were also communicated to planners	Helfield et al. 2007, Palm et al. 2007, Gardeström et al. 2013, Polvi et al. 2014, Hasselquist et al. 2015, Nilsson et al. 2015, Vindel River Life 2015

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