



Guest Editorial, part of a Special Feature on [Ecological Restoration, Ecosystem Services, and Land Use](#)

Ecological restoration, ecosystem services, and land use: a European perspective

Anne Tolvanen^{1,2} and James Aronson^{3,4}

ABSTRACT. This special feature provides an overview on how the ecosystem service concept has been and can be incorporated into the science, practice, and policies of ecological restoration (ER) and evidence-based land-use. It includes an edited selection of eleven invited and peer-reviewed papers based on presentations given during the 9th European Conference on Ecological Restoration in 2014. The focus is on Europe, but many contributors also make appraisals and recommendations at the global scale. Based on the contributors' papers, and our own overview of the promise of ecological restoration in the existing international treaties, coalitions, and conventions, we propose that the following actions could contribute to the positive impacts of ER on biodiversity maintenance, ecosystem functioning, progressive mainstreaming the concepts of both ER and ecosystem services, significant mitigation and offsetting of anthropogenic climate change, and lasting enhancement of both ecosystem and human health: ! ER should be incorporated into land use planning, wherever needed, and the synergies and trade-offs of different land use scenarios should be assessed in terms of their impacts on ecosystem services. ! The discourse of ER should be enlarged, wherever it is needed, to include multifunctional land use that simultaneously supports sustainable production systems, built environments, and the quality and quantity of diverse ecosystem services. This approach will generate ecological, social, and economic benefits in the long run. ! Monitoring and evaluation of ER projects should be a continuous process involving careful selection of indicators chosen with the full range of stakeholders in mind, and a sufficiently long-term perspective to catch the progress of long-term or highly dynamic ecosystem processes. ! Scientists should actively participate in policy and land management discussions in order to give their views on the potential outcomes of decisions. ! Greater cooperation and exchanges are needed within the EU and globally in order to accelerate the upscaling, improvement, and mainstreaming of both large-scale ER and the science and application of the ecosystem services concept.

Key Words: *Biodiversity; climate change; ecological rehabilitation; ecological restoration; ecosystem services; European Union; EU2020 strategy; land use; policy; SER; Society for Ecological Restoration*

INTRODUCTION

Knowledge of the potential of ecological restoration (ER) and demand for scaling it up are on the rise worldwide. The concept and emerging science of ecosystem services will help, because ER helps address biodiversity and ecosystem services objectives simultaneously (Bullock et al. 2011). As is well known, healthy ecosystems - that is systems that are well-organized, self-organizing, and functioning in a coherent landscape matrix - contribute to and improve the health and well-being of people (Millennium Ecosystem Assessment 2003).

What is new today is the awareness that we can - if we work together, across disciplinary, economic, and ideological divides - actually augment renewable and cultivated natural capital through ER, thereby maintaining biodiversity, and enhancing the quality and range of ecosystem goods and services on which our own health and wellbeing depend (Brauman et al. 2007, Aronson et al. 2016, and references therein).

The ecosystem service concept and the efforts to value ecosystem services are attempts to create explicit and binding values related to non-monetary as well as monetary benefits derived from those services. Despite the concern that the inherent value of "Nature" may be overlooked if economic valuation alone drives decision-making (Meine et al. 2006, Schröter et al. 2014), the ecosystem services concept provides a common ground to discuss and take policy decisions regarding the environmental footprint, and long-term desirability and sustainability, of diverse land and water uses

(Naeem 2002, Aronson et al. 2007, TEEB 2010, Neßhöver et al. 2011, Alexander et al. 2016). In this context, it is critical to clarify the possible roles, limitations, and opportunities provided by the science and application of both ER and ecosystem services in the safeguarding of biodiversity, and the maintenance of well-functioning, well-integrated ecosystems in our finite, bounded world (CBD 2012, Aronson and Alexander 2013).

The 9th European Conference on Ecological Restoration, organized by the Society for Ecological Restoration Europe Chapter (SERE), was held in Oulu, Finland in August 2014. This was the time when the planning of the fulfilment of 15% restoration target had just begun in most EU countries. Almost 400 participants from 36 countries attended, bringing experience and perspectives from natural and social sciences, EU policy spheres, land management, private companies, consultancy firms, and NGOs concerned with restoration and conservation. These delegates gathered together to discuss the integration of the emerging science of ecosystem services, the science and practice of ER, and myriad timely land use questions. By collecting an edited selection of eleven papers presented during the Conference this special feature provides an overview and appraisal of how the ecosystem service concept has been and can be incorporated into the science, practice, and policies of ER and land-use. Another special issue arising from the same SERE2014 conference addresses the concept of biodiversity and ecosystem services at mining and industrial sites in particular (see Prach and Tolvanen 2016).

¹Natural Resources Institute Finland, Oulu, ²Department of Ecology and Genetics, University of Oulu, ³Missouri Botanical Garden, St. Louis, MO, USA, ⁴Centre d'Ecologie Fonctionnelle et Evolutive (UMR 5175-Campus du CNRS), Montpellier, France

LEGISLATION AND POLICY RELATED TO ECOLOGICAL RESTORATION

During the last decade, ER has become increasingly prominent in global, national and regional treaties, coalitions, and UN conventions. The European Commission was a pioneer in these efforts (European Commission 2011), through its Biodiversity Strategy 2020 program which includes a target to 'restore' or more accurately - to begin restoring 15% of all degraded ecosystems in the EU by 2020. The next year (CBD 2012), the UN Convention on Biological Diversity took this same goal to a global scale. Then, in 2015, strong support and 'soft laws' calling for large-scale ecological restoration were provided by the UNCCD (2015), UNFCCC (2015), and the UN General Assembly (UN 2015). These conventions emphasize the feedback between land degradation and anthropogenic climate change, and assert that ER and sustainable land management are effective and essential means to reduce greenhouse gas emissions. Still, a great deal remains to be done to improve the ecologically healthy relationship "between nature and culture", to borrow from the Mission statement of the Society for Ecological Restoration (SER). The Convention on Combating Desertification (UNCCD) has launched a program to achieve Land Degradation Neutrality (Reed and Stringer 2016), in which ER is one of the key components. We also note the growing number of governments creating new policies and laws with respect to ER and ecosystem services (Colombia, Brazil, South Africa, New Zealand, the US, Canada, among others, and also the EU).

So far, the progress of the implementation of the 15% restoration target in the EU has been modest. All member states failed to honor their commitment to deliver a sound national restoration prioritization framework by the end of 2014 (Cortina-Segarra et al. 2016), and few member states have even started to work out their restoration prioritization framework or consider alternative strategies to counterbalance ecosystem degradation. There may be many reasons for the poor implementation of EU biodiversity strategy thus far, such as costs and burdens placed on authorities and stakeholders, the ability to simultaneously achieve the goals of other EU policies (Milieu, IEEP and ICF 2016) and, in some cases, impractical initial restoration targets in relation to the level of degradation and land use (Kotiaho 2015). Jørgensen (2015) also points out in this special feature that there is a risk that the focus of policy-makers may shift from biodiversity itself to the incentive to maximize "restored" areas in order to meet national commitments to the EU goals. The reason for concern on this subject is that ER has three different roles in both CBD and EU biodiversity policy documents, namely as an objective, as a target, and as a tool. As ecological restoration itself has been listed as an objective of the EU policy, meeting that objective through the use of a tool deployed to reach a numerical target becomes an accounting exercise instead of something more holistic and far-seeing (Jørgensen 2015).

Furthermore, in the EU, biodiversity offsetting is a recent policy approach employed or evoked in attempts to better align economic development with nature protection (Shoukens and Cliquet 2016). The EU Nature directives are facing opposition not only from some businesses and industrial sectors, but also from some Member States that struggle with conservation objectives. In this special feature, Shoukens and Cliquet (2016) provide an overview of compensation approaches and their

potential implications on the effectiveness of EU Nature Directives. They show that that ER cannot be used as mitigation in the context of the EU Nature Directives, unless it can be demonstrated that they directly mitigate or reduce the effects linked to real estate development on the targeted areas or patches of habitats. Coordinated and proactive application of restoration, and incorporation of adaptive management at permit of planning level, could constitute a promising pathway towards more sustainable project development (Shoukens and Cliquet 2016).

EVALUATION OF ECOSYSTEM SERVICE DELIVERY IN ECOLOGICAL RESTORATION

Careful evaluation of ER is important in assessing the success and cost-efficiency of restoration projects, not only for communicating the information generated but also for securing future funding and land areas for restoration projects. Nevertheless, formal evaluation often lacks altogether in restoration projects, or is restricted to a single or just a few post-restoration events (Suding 2011). Poor, short-term, and poorly documented evaluation creates a risk that inefficient or ineffective methods and tools will continue to be needlessly used (Nilsson et al. 2016). In order to holistically assess the impacts of the varying restoration processes set in motion in a project, evaluation should be a continuous activity (Allen et al. 2002) promoting adaptive management. In this special feature Nilsson et al. (2016) develop a conceptual framework for evaluating the process of ER. They identify three major phases; planning, implementation, and monitoring, and show that evaluation can occur both within and between each of these phases. To improve the restoration process, and to transfer the knowledge and knowhow generated to future projects and programs, more formal, and more sustained evaluation procedures are called for. They should also involve all relevant stakeholders, and generate active documentation and dissemination of the results, experiences, successes, and failures (Nilsson et al 2016).

A sufficiently long-term time frame is also needed to allow scientific evaluation of the impact of restoration projects on biophysical parameters. Especially in regions with short vegetative growing seasons, ecological processes may be slow to proceed, with the result that some of the desired restoration outcomes may take decades or even centuries to achieve. But, the processes *per se* are also important, especially in highly dynamic ecosystems. In their contribution in this special issue, Boerema et al. (2016) show that in highly dynamic ecosystems a 'snapshot' evaluation of a restoration project can give a false estimate or indication of success.

The diversity of restoration aims has raised a number of conceptual and practical implications for the way that restoration projects are monitored and evaluated (Clewell and Aronson 2006, Hughes et al. 2016). Biodiversity targets, which are often seen as the principal target of restoration, may be only partially correlated with ecosystem service targets and outcomes. As a result, metrics for monitoring biodiversity do not necessarily coincide with those for monitoring ecosystem services. Hughes et al. (2016) discuss the choice of metrics for monitoring ecosystem services and the difficulties of assessing the interactions between ecosystem processes, biodiversity changes, and ecosystem services affected by restoration projects. They conclude that reporting the achievements of a project in terms of biodiversity metrics alone

gives a very different context for valuing its achievements compared with reporting impacts on ecosystem service range and provision. Hence the choice of monitoring metrics and the incompatibilities of measurement scale and sampling design of many biodiversity and ecosystem service metrics can have a significant impact on the results reported, on who values what in a given restoration project, on perceptions of cost-effectiveness and, finally, on how decisions are made based on the monitoring results (Hughes et al. 2016).

ECOLOGICAL RESTORATION WITHIN MULTIPLE LAND USE SCHEMES

Already a decade ago, de Groot (2006) pointed out that multifunctional land use is an operational concept to simultaneously plan for and generate ecological, social, and economic benefits. Although this view is commonly accepted now, more efforts are needed to insure the integration - where needed - of ER as a land use in large-scale land use planning. Socioeconomic drivers often motivate the decision to start an ER project (Hagen et al. 2013). In order to get support, restoration projects and larger programs need to demonstrate their importance and success in relation to other land uses and the ecosystem services they each provide (Tolvanen et al. 2012). They also require the coordination of land uses and management over a larger area, usually with a range of partners, land owners, and stakeholders (Adams et al. 2016). For example, Marttila et al. 2016 show in their contribution to this special feature that expectations about stream restoration outcomes reveal different priorities among sets of stakeholders in a given project. How well these expectations on landscape value, fisheries opportunities, and regulating services, etc., are or may be met, influences perceptions of success or failure. Adams et al. (2016) also emphasize in this special issue that mutual trust among stakeholders and institutional strategies are needed to ensure that conservation and ecosystem services gains are not reversed when funding runs out, private owners change priorities, or land tenure changes occur.

As many benefits of ER are of non-market and public, they are rarely represented or defended in conventional decision-making processes. An essential step in the process is to make the consequences of different land use scenarios as explicit as possible (Decler et al. 2016). In their analysis of this problem, Decler et al. (2016) show that the broader benefits of restoration, e.g., those arising from the avoidance or reduction of flood hazards, and the increase of tourism and recreation opportunities, etc., may well outweigh the costs to individual landowners due to decrease of food production. These kinds of quantitative analyses are important in identifying synergies and trade-offs among alternative land use planning policies and restoration scenarios.

Evidence-based land use policy relies on the availability of scientific information (Decler et al. 2016, Kangas et al. 2016). Nevertheless, scientific information often requires complicated analyses and high level expert evaluation. To have real effect, scientific information should be inserted - and, where needed, simplified - to fit into decision criteria and/or tools, where biodiversity conservation through set-asides, and ER, are assessed together with other land uses, and the ecosystem services they each deliver. In this way, optimum management interventions and operations can be targeted to the areas where they are best suited.

For example, in their contribution to this special feature, Kangas et al (2016) develop ecological criteria to locate suitable areas for tourism and recreational infrastructure and to assess the success of nature conservation in a study region with concurrent needs for the development of nature conservation, tourism and recreation, and forestry. Their method can be transferred and applied to other regions and land uses such as the biodiversity conservation in the city planning (Kangas et al. 2013) and the development of tourism and mining areas (Kangas, Tolvanen, Juutinen, unpublished manuscript) provided that the scoring is adapted to local conditions and available data sets (Kangas et al. 2016). Similar to the proposals of Decler et al. (2016), however, this quantitative assessment was made possible through of large amounts of high quality data, which may not always be possible for similar planning approaches elsewhere.

Echoing Bullock et al. (2011) and others, Alexander et al. (2016) argue that there is a strong inherent relationship between ER and the ecosystem services concept, with the latter providing some guidance on how ER may be planned and implemented at landscape and regional scales. Clearly science and technology alone will not allow meeting the potential or the demand for large-scale ER. Similarly, jurisdiction will also not be enough to truly mainstream and assure longevity for restoration projects and programs even though they may be essential to integrating them within larger landscape mosaics and regions (Ford et al. 2015).

CONCLUSIONS

Since 2014, discussion of the above-cited 15% target has been lively in the EU; unfortunately little has been achieved in relation to the key target (Cortina-Segarra et al. 2016). Ongoing threat exists that the EU target to halt the degradation of biodiversity will be 'watered down'. Scientists should actively participate in the political discourse in order to keep ER in the agenda and give their views on the potential outcomes of land use decisions. Concerning climate change, it should be acknowledged that sustainable land management, ecological rehabilitation (focused primarily on functionality), ER, and integrated land use planning, provide immediate, cost-effective, and potentially large-scale mitigation benefits (UNCCD 2015). Furthermore, land and ecosystem degradation processes are known to be both causes and a consequence of anthropogenic climate change; imprudent agricultural practices, deforestation, and ecosystem conversion of natural or semi-natural areas to built environments spur almost 25% of total global greenhouse gas emissions (IPCC 2014). The emissions can and should be reduced through more sustainable land use and management, combined with land rehabilitation and ecosystem restoration activities.

In closing, let us go back to our first sentence in this synthesis paper. Knowledge of the potential of ecological restoration and demand for scaling it up, are on the rise worldwide. We're on a 'roll' - hopefully - and we need to nurture it. In Europe as elsewhere, the key challenge of achieving effective, long-lasting ER in all ecosystem types is that our exponential use of renewable and non-renewable natural capital must be weighed against the myriad benefits to present and future generations to be gained from maintaining biodiversity and 'healthy' environments and the restoration and rehabilitation of degraded areas and ecosystems. Multidisciplinary research, evaluation strategies, and far-sighted and more just national policies must come to be the rule rather

than exceptions in the discussion around ER. In periods of economic and political jolts and crisis, in particular, it is tempting to seek quick solutions that bring short-term ease to the economy, but these may well have devastating long-term environmental consequences adversely affecting the well-being of future generations of humans and indeed all life on Earth.

Responses to this article can be read online at:
<http://www.ecologyandsociety.org/issues/responses.php/9048>

Acknowledgments:

We gratefully acknowledge all organizations and foundations that provided financial support for the 9th European Conference on Ecological Restoration and the present special feature: Natural Resources Institute Finland (and the preceding Finnish Forest Research Institute), LIFE Peat Land Use project (LIFE12 ENV/FI/000150), Metsähallitus, the Ministry of the Environment, Ministry of Agriculture and Forestry, Federation of Finnish Learned Societies, Maj and Tor Nessling Foundation, Council of Oulu Region, Vapo Oy, Oulun Energia, and the City of Oulu.

LITERATURE CITED

- Adams, W. M., I. D. Hodge, N. A. Macgregor, and L. Sandbrook. 2016. Creating restoration landscapes: partnerships in large-scale conservation in the UK. *Ecology and Society* 21(3):1. <http://dx.doi.org/10.5751/es-08498-210301>
- Alexander, S., J. Aronson, O. Whaley, and D. Lamb. 2016. The relationship between ecological restoration and the ecosystem services concept. *Ecology and Society* 21(1):34. [http://dx.doi.org/10.1890/1051-0761\(2002\)012\[1418:EROSPP\]2.0.CO;2](http://dx.doi.org/10.1890/1051-0761(2002)012[1418:EROSPP]2.0.CO;2)
- Allen, C. D., M. Savage, D. A. Falk, K. F. Suckling, T. W. Swetnam, T. Schulke, P. B. Stacey, P. Morgan, M. Hoffman, and J. T. Klingel. 2002. Ecological restoration of southwestern ponderosa pine ecosystems: a broad perspective. *Ecological Applications* 12:1418-1433. [https://doi.org/10.1890/1051-0761\(2002\)012\[1418:erospp\]2.0.co;2](https://doi.org/10.1890/1051-0761(2002)012[1418:erospp]2.0.co;2)
- Aronson, J., and S. Alexander. 2013. Ecosystem restoration is now a global priority: time to roll up our sleeves. *Restoration Ecology* 21:293-296. <http://dx.doi.org/10.1111/rec.12011>
- Aronson, J., S. J. Milton, and J. N. Blignaut, editors. 2007. *Restoring natural capital: science, business, and practice*. Island press, Washington, DC. <http://dx.doi.org/10.3368/er.24.1.22>
- Aronson, J. C., C. M. Blatt, and T. B. Aronson. 2016. Restoring ecosystem health to improve human health and well-being: physicians and restoration ecologists unite in a common cause. *Ecology and Society* 21(4):39. <http://dx.doi.org/10.5751/es-08974-210439>
- Boerema, A., L. Geerts, L. Oosterlee, S. Temmerman, and P. Meire. 2016. Ecosystem service delivery in restoration projects: the effect of ecological succession on the benefits of tidal marsh restoration. *Ecology and Society* 21(2):10. <http://dx.doi.org/10.5751/es-08372-210210>
- Brauman, K. A., G. C. Daily, T. K. Duarte, and H. A. Mooney. 2007. The nature and value of ecosystem services: An overview highlighting hydrologic services. *Annual Review of Environment and Resources* 32:67-98. <http://dx.doi.org/10.1146/annurev.energy.32.031306.102758>
- Bullock, J. M., J. Aronson, A. C. Newton, R. F. Pywell, and J. M. Rey-Benayas. 2011. Restoration of ecosystem services and biodiversity: conflicts and opportunities. *Trends in Evolution and Ecology* 26:541-549. <http://dx.doi.org/10.1016/j.tree.2011.06.011>
- Clewell, A.F., and J. Aronson. 2006. Motivations for the Restoration of Ecosystems. *Conservation Biology* 20:420-428. <http://dx.doi.org/10.1111/j.1523-1739.2006.00340.x>
- Convention on Biological Diversity (CBD) 2012. UNEP/CBD/COP Decision XI/16. Ecosystem restoration. Convention on Biological Diversity, Hyderabad, India. [online] URL: <http://www.cbd.int/doc/decisions/cop-11/cop-11-dec-16-en.pdf>
- Cortina-Segarra, J., K. Decler, and J. Kollmann. 2016. Speed restoration of EU ecosystems. *Nature* 535:231. <http://dx.doi.org/10.1038/535231d>
- Decler, K., J. Wouters, S. Jacobs, J. Staes, T. Spanhove, P. Meire, and R. Van Diggelen. 2016. Mapping wetland loss and restoration potential in Flanders (Belgium): an ecosystem service perspective. *Ecology and Society* 21(4):46 <https://doi.org/10.5751/ES-08964-210446>
- de Groot, H. 2006. Function-analysis and valuation as a tool to assess land use conflicts in planning for sustainable, multi-functional landscapes. *Landscape and Urban Planning* 75:175-186. <http://dx.doi.org/10.1016/j.landurbplan.2005.02.016>
- European Commission. 2011. The EU Biodiversity strategy to 2020. 33 pp. [online] URL: <http://ec.europa.eu/environment/nature/info/pubs/docs/brochures/2020%20Biod%20brochure%20final%20lowres.pdf>
- Ford, A. E. S., H. Graham, and P. C. L. White. 2015. Integrating human and ecosystem health through ecosystem Services Frameworks. *EcoHealth* 12:660-671. <http://dx.doi.org/10.1007/s10393-015-1041-4>
- Hagen, D., K. Svavarsdottir, C. Nilsson, A. Tolvanen, K. Raulund-Rasmussen, Á. L. Aradóttir, A. Fosaa, and G. Halldorsson. 2013. Ecological and social dimensions of ecosystem restoration in the Nordic countries. *Ecology and Society* 18(4):34. <http://dx.doi.org/10.5751/es-05891-180434>
- Hughes, F. M. R., W. M. Adams, S. H. M. Butchart, R. H. Field, K. S.-H. Peh, and S. Warrington. 2016. The challenges of integrating biodiversity and ecosystem services monitoring and evaluation at a landscape-scale wetland restoration project in the UK. *Ecology and Society* 21(3):10. <http://dx.doi.org/10.5751/es-08616-210310>
- Intergovernmental Panel on Climate Change (IPCC). 2014: Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. IPCC, Geneva, Switzerland, 151 pp. [online] URL: http://ipcc.ch/pdf/assessment-report/ar5/syr/SYR_AR5_FINAL_full.pdf

- Jørgensen, D. 2015. Ecological restoration as objective, target, and tool in international biodiversity policy. *Ecology and Society* 20(4):43. <http://dx.doi.org/10.5751/es-08149-200443>
- Kangas, K. M., A. Tolvanen, O. Tarvainen, A. Nikula, V. Nivala, E. Huhta, and A. Jäkäläniemi. 2016. A method for assessing ecological values to reconcile multiple land use needs. *Ecology and Society* 21(3):5. <http://dx.doi.org/10.5751/es-08590-210305>
- Kangas, K., A. Tolvanen, M. Keränen, and J. Moilanen. 2013. Oulun luonnon monimuotoisuus, VILMO-Viheralueverkosto ja luonnon monimuotoisuus [in Finnish]. Finnish Forest Research Institute and the City of Oulu, Finland. [online] URL: http://www.ouka.fi/c/document_library/get_file?uuid=69340961-aa5f-44ea-82c4-9e22a26eaacb&groupId=64220
- Kotiaho, J. 2015. Target for ecosystem repair is impractical. *Nature* 519:33. <http://dx.doi.org/10.1038/519033a>
- Marttila, M., K. Kyllönen, and T. P. Karjalainen. 2016. Social success of in-stream habitat improvement: from fisheries enhancement to the delivery of multiple ecosystem services. *Ecology and Society* 21(1):4. <http://dx.doi.org/10.5751/es-08118-210104>
- Meine, C., M. Soulé, and R. F. Noss. 2006. "A mission-driven discipline": the growth of conservation biology. *Conservation Biology* 20:631-651. <http://dx.doi.org/10.1111/j.1523-1739.2006.00449.x>
- Milieu, IEEP and ICF. 2016. Evaluation Study to support the Fitness Check of the Birds and Habitats Directives, March 2016. [online] URL: http://d2ouvy59p0dg6k.cloudfront.net/downloads/study_evaluation_to_support_fitness_check_of_nature_directives_final.pdf
- Millennium Ecosystem Assessment 2003. *Ecosystems and Human Well-being: A Framework for Assessment*. 266 pp. Island Press, Washington, DC.
- Naeem, S. 2002. Ecosystem consequences of biodiversity loss: the evolution of a paradigm. *Ecology* 83(6):1537-1552. [http://dx.doi.org/10.1890/0012-9658\(2002\)083\[1537:ecobl\]2.0.co;2](http://dx.doi.org/10.1890/0012-9658(2002)083[1537:ecobl]2.0.co;2)
- Neßhöver, C., J. Aronson, J. Blignaut, F. Eppink, A. Vakrou, H. Wittmer, and R. de Groot. 2011. Investing in ecological infrastructure. In: P. Ten Brink, editor. *The economics of ecosystems and biodiversity in national and international policy making*. pp. 1-448. Earthscan, London, UK.
- Nilsson, C., A. L. Aradottir, D. Hagen, G. Halldórsson, K. Høegh, R. J. Mitchell, K. Raulund-Rasmussen, K. Svavarsdóttir, A. Tolvanen, and S. D. Wilson. 2016. Evaluating the process of ecological restoration. *Ecology and Society* 21(1):41. <http://dx.doi.org/10.5751/es-08289-210141>
- Prach, K., and A. Tolvanen. 2016. How can we restore biodiversity and ecosystem services in mining and industrial sites? *Environmental Science and Pollution Research* 23:13732-13744. <http://dx.doi.org/s11356-016-7113-3>
- Reed, M. S., and L. C. Stringer. 2016. *Land Degradation, Desertification and Climate Change*. Routledge, New York.
- Schröter, M., E. H. van der Zanden, A. P. E. van Oudenhoven, R. P. Remme, H. M. Serna-Chavez, R. S. de Groot, and P. Opdam. 2014. Ecosystem services as a contested concept: a synthesis of critique and counter-arguments. *Conservation Letters* 7:514-523. <http://dx.doi.org/10.1111/conl.12091>
- Schoukens, H., and A. Cliquet. 2016. Biodiversity offsetting and restoration under the European Union Habitats Directive: balancing between no net loss and deathbed conservation? *Ecology and Society* 21(4):10. <http://dx.doi.org/10.5751/es-08456-210410>
- Suding, K. N. 2011. Toward an era of restoration in ecology: successes, failures, and opportunities ahead. *Annual Review of Ecology, Evolution, and Systematics* 42:465-487. <http://dx.doi.org/10.1146/annurev-ecolsys-102710-145115>
- Tolvanen, A., A. Juutinen, and R. Svento. 2012. Preferences of local people for the use of peatlands: the case of the richest peatland region in Finland. *Ecology and Society* 18(2):19. <http://dx.doi.org/10.5751/es-05496-180219>
- TEEB. 2010. The Economics of Ecosystems and Biodiversity: Mainstreaming the Economics of Nature: A synthesis of the approach, conclusions and recommendations of TEEB. [online] URL: <http://www.unep.org/pdf/LinkClick.pdf>
- United Nations (UN). 2015. Transforming Our World: The 2030 Agenda for Sustainable Development. [online] URL: <https://sustainabledevelopment.un.org/post2015/transformingourworld>
- United Nations Convention to Combat Desertification (UNCCD). 2009. Basic facts about desertification and the Convention. [online] URL <http://www.unccd.int/Lists/SiteDocumentLibrary/Publications/factsheets-eng.pdf>
- United Nations Convention to Combat Desertification (UNCCD). 2015. UN Convention to Combat Desertification. Land matters for climate. Reducing the gap and approaching the target. 24 pp. [online] URL: http://www.unccd.int/Lists/SiteDocumentLibrary/Publications/2015Nov_Land_matters_For_Climate_ENG.pdf
- United Nations Framework Convention on Climate Change (UNFCCC). 2015. United Nations Framework Convention on Climate Change: Paris agreement. [online] URL http://unfccc.int/paris_agreement/items/9485.php