Landscape and Ecological Engineering (2019) 15:131–132
https://doi.org/10.1007/s11355-019-00376-9

SPECIAL FEATURE: FOREWORD

Ecological Resilience of Ecosystems to Human Impacts: Resilience of Plants and Animals

Ecological resilience of ecosystems to human impacts: resilience of plants and animals

Junko Morimoto[1] · Junjiro Negishi[1,2]

Published online: 21 March 2019

Resilience: the key for the adaptation to the climate change and global warming

Climate change associated with global warming has already caused extreme weather in various regions of the world. Especially in the East Asia, heavy typhoons and rainy season fronts have frequently caused the damage of heavy rain, floods, and sediment in recent years (Japan Meteorological Agency 2014). And it is expected that these weather disasters will expand in the future (Ministry of Environment et al. 2018). Furthermore, influences of extreme weather on natural ecosystems are also predicted, i.e., changes in water quality and flow regime due to altered precipitation characteristics, and changes in distribution of vegetation and wildlife due to the rise of air temperature and water temperature.

Rockström et al. (2009) raised nine earth-system processes essential for survival of humanity, and showed the planetary boundary defining the safe operating space for humanity with respect to the Earth system. They also claimed that human activities can undermine the resilience of ecosystems and can increase the risk of crossing the planetary boundary. Hence, the quantification and enhancement of ecosystem resilience are required for the adaptation to climate change and global warming (Angeler et al. 2018). To what extent does the ecosystems on the earth have the resilience to such severe natural disturbances?

Originally, natural disturbance favors biodiversity (D'Odorico and Bhattachan 2012) and builds biological capacity to adapt to or resist change (Palmer et al. 2008; Dee et al. 2018). And it has an important attribute conferring resilience within ecosystems (Li et al. 2012). But will the artificially modified ecosystems have enough resilience to combat intensifying natural disturbances? We still do not have much knowledge on it (Côté and Darling 2010; Andersson 2018).

✉ Junko Morimoto
jmo1219@for.agr.hokudai.ac.jp

Junjiro Negishi
negishi@ees.hokudai.ac.jp

1 Graduate School of Agriculture, Hokkaido University, Sapporo 060-8589, Hokkaido, Japan

2 Faculty of Environmental Earth Science, Hokkaido University, Sapporo 060-0810, Hokkaido, Japan

Contribution of ecological resilience of ecosystems to the SGD's target

In Sustainable Development Goals (SDGs) of the 2030 Agenda for Sustainable Development, "Sustainable development" has been defined as development that meets the needs of the present without compromising the ability of future generations to meet their own needs, which calls for concerted efforts toward building an inclusive, sustainable, and resilient future for people and planet. It also declares that it is crucial to harmonize three core elements: economic growth, social inclusion, and environmental protection for sustainable development to be achieved. What can the ecological resilience of ecosystems contribute to the SGD's target in terms of environmental protection?

Quotation from the new agenda of SGD:

> ….We recognize that social and economic development depends on the sustainable management of our planet's natural resources. We are therefore determined to conserve and sustainably use oceans and seas, freshwater resources, as well as forests, mountains and drylands and to protect biodiversity, ecosystems and wildlife. We are also determined to promote sustainable tourism, to tackle water scarcity and water pollution, to strengthen cooperation on desertification, dust storms, land degradation and drought and to promote resilience and disaster risk reduction.

It is necessary to expand our scope of vision on ecosystem management from aiming only for conserving biodiversity and ecosystem services, to aiming for enhancing ecological resilience of ecosystems (Timpane-Padgham et al. 2017; Aslan et al. 2018). Resilience is recognized as a key element in the implementation of the green infrastructure, a practical way to manage social and natural capital in a population-declining society under the climate change (Nakamura and Ishiyama 2018; Natuhara 2018). We planned this special feature to become an essential step in East Asia for the adaptation to the climate change to avoid human activity crossing the planetary boundary.

Aims and scope of this special feature

In this special feature, readers will understand how the altered ecosystems by human respond to the catastrophic natural disturbances, i.e.; how the forest salvage logged recovered from the windthrow damage (Morimoto et al. 2019), how the aquatic community in polluted stream restored from the catastrophic flood damage (Negishi et al. 2019), how the satoyama secondary forests restored after being damaged by insects and deer (Nagashima et al. 2019), how the moss community in Japanese gardens adapted to urban heat island (Oishi 2019a, b), and how the artificial coastal forests recovered from the tsunami damage (Tomita and Kanno 2019).

This special feature aims to offer ideas on the direction of research necessary for quantifying ecological resilience of ecosystems for scientists, and ideas on ecosystem management to enhance the ecological resilience of ecosystems for policy makers, in preparation against intensifying natural disturbance by showing various examples. Most of articles in this issue are developed from the presentations of the session on this topic at the ELR2017 Nagoya and the 8th ICLEE held in September 2017.

References

Andersson E (2018) Functional landscapes in cities: a systems approach. Landsc Ecol Eng 14:193–199

Angeler DG, Allen CR, Garmestani A, Pope KL, Twidwell D, Bundschuh M (2018) Resilience in environmental risk and impact assessment: concepts and measurement. Bull Environ Contam Toxicol 101:543–548

Aslan CE, Petersen B, Shiels AB, Haines W, Liang CT (2018) Operationalizing resilience for conservation objectives: the 4S's. Restor Ecol 26:1032–1038

Côté IM, Darling ES (2010) Rethinking ecosystem resilience in the face of climate change. PLoS Biol 8:e1000438

Dee S, Korol A, Ahn C, Lee JA, Means M (2018) Patterns of vegetation and soil properties in a beaver-created wetland located on the Coastal Plain of Virginia. Landsc Ecol Eng 14:209–219

D'Odorico P, Bhattachan A (2012) Hydrologic variability in dryland regions: impacts on ecosystem dynamics and food security. Philos Trans R Soc Lond B Biol Sci 367:3145–3157

Japan Meteorological Agency (2014) Anomalous weather report: extreme weather and climate change in the world in recent years—its actual condition and prospects **(in Japanese)**

Li H, Xing P, Wu QL (2012) The high resilience of the bacterioplankton community in the face of a catastrophic disturbance by a heavy Microcystis bloom. FEMS Microbiol Ecol 82:192–201

Ministry of Environment, Ministry of Education, Culture, Sports, Science and Technology, Ministry of Agriculture, Forestry and Fisheries, Ministry of Land, Infrastructure, Transport and Tourism, and Meteorological Agency of Japan (2018) Consolidated report on observations, projections and impact assessments of climate change: climate change and its impacts in Japan. FY2018 **(in Japanese)**

Morimoto J, Umebayashi T, Suzuki SN, Owari T, Nishimura N, Ishibashi S, Shibuya M, Hara T (2019) Long-term effects of salvage logging after a catastrophic wind disturbance on forest structure in northern Japan. Landsc Ecol Eng. https://doi.org/10.1007/s11355-019-00375-w

Nagashima K, Shimomura T, Tanaka K (2019) Early-stage vegetation recovery in forests damaged by oak wilt disease and deer browsing: effects of deer-proof fencing and clear-cutting. Landsc Ecol Eng. https://doi.org/10.1007/s11355-019-00372-z

Nakamura F, Ishiyama I (2018) Adaptation to climate change and conservation of biodiversity using green infrastructure. In: Proceedings of 3rd international conference of "integrative science and sustainable development of rivers", Lyon-France

Natuhara Y (2018) Green infrastructure: innovative use of indigenous ecosystems and knowledge. Landsc Ecol Eng 14:187–192

Negishi JN, Terui A, Badrun N, Miura K, Oiso T, Sumitomo K, Kyuka T, Yonemoto M, Nakamura F (2019) High resilience of aquatic community to a 100-year flood in a gravel-bed river. Landsc Ecol Eng. https://doi.org/10.1007/s11355-019-00373-y

Oishi Y (2019a) The influence of microclimate on bryophyte diversity in an urban Japanese garden landscape. Landsc Ecol Eng. https://doi.org/10.1007/s11355-018-0354-1

Oishi Y (2019b) Urban heat island effects on moss gardens in Kyoto, Japan. Landsc Ecol Eng. https://doi.org/10.1007/s11355-018-0356-z

Palmer MA, Reidy Liermann CA, Nilsson C, Flörke M, Alcamo J, Lake PS, Bond N (2008) Climate change and the world's river basins: anticipating management options. Front Ecol Environ 6:81–89

Rockström J, Steffen W, Noone K, Persson Å, Chapin Iii FS, Lambin EF, Lenton TM, Scheffer M, Folke C, Schellnhuber HJ, Nykvist B, de Wit CA, Hughes T, van der Leeuw S, Rodhe H, Sörlin S, Snyder PK, Costanza R, Svedin U, Falkenmark M, Karlberg L, Corell RW, Fabry VJ, Hansen J, Walker B, Liverman D, Richardson K, Crutzen P, Foley JA (2009) A safe operating space for humanity. Nature 461:472

Timpane-Padgham BL, Beechie T, Klinger T (2017) A systematic review of ecological attributes that confer resilience to climate change in environmental restoration. PLoS One 12:e0173812

Tomita M, Kanno H (2019) Regional landscape-scale comparison of species composition and recruitment in remnant tree patches 3 years after the 2011 Great East Japan Earthquake and tsunami. Landsc Ecol Eng. https://doi.org/10.1007/s11355-018-0364-z