Research Article

ACTA ZOOLOGICA BULGARICA
Acta zool. bulg., Suppl. 11, 2018: 95-98

Why is it necessary to assess the ecosystems and their services – the case of Oriental beech forests in Bulgaria

Gergana T. Georgieva, Kremena P. Gocheva, & Nesho H. Chipev

Institute of Biodiversity and Ecosystem Research at the Bulgarian Academy of Sciences (IBER-BAS), Gagarin Street 2, 1113-Sofia, Bulgaria; ger_georgieva@abv.bg; kremena.gocheva@gmail.com; nchipev@abv.bg

Abstract: The present paper is aiming at testing the National Methodological Framework for assessment ecosystem condition and ecosystem services on the local scale. In a pilot case study an assessment of the condition of Oriental beech (*Fagus orientalis* Lypski) ecosystems in Strandzha Mountain was carried out. The main conclusion to emerge is that the studied Oriental beech ecosystems in Strandzha Mt were in a good structural-functional condition. They have preserved a high potential to provide ecosystem services. As a whole, the developed National approach of assessment the condition of ecosystems presented a satisfactory *ad hoc* picture of the ecosystems' condition of Oriental beech ecosystems. Gaps in the data sets and lack of time series data on main condition indicators were the main constrains in the assessment process at the local scale.

Key words: Strandzha Mountain, ecosystem condition, ecosystem services potential

Introduction

Human well-being depends on nature and its resources, which provide vital services including fertile soil, fresh water, pollination, natural flood protection and climate regulation. The ecosystems, habitats and species that form the natural capital providing these services are under risk of being degraded or lost as a result of human activity (Newbold et al. 2015). The ecosystem services (ESS) concept emphasizes the multiple benefits of ecosystems to humans (MEA 2005) and its use can facilitate collaboration between scientists, professionals, decision-makers, and other stakeholders.

Recognizing the need of a holistic approach and the shift towards ecosystem level assessment, mapping, monitoring and reporting the European Biodiversity Strategy to 2020 (EC 2011) in its Target 2, Action 5 (*Improve knowledge of ecosystems and their services in the EU*), requires the EU member states to map and assess the condition of ecosystems and ecosystem services in their national territories. In Bulgaria this process is carried out under the programme *BG03 Biodiversity and ecosystem services*, supported financially by the European Economic Area Financial Mechanism (EEA FM) for mapping outside NATURA 2000.

In Bulgaria, the ecosystems mapping and assessment process followed the National Methodological Framework (MetEcosMap 2017), as a step-by-step process following the scheme and steps proposed by the MAES group (Maes et al. 2016). An urgent need exists to test the applicability of the ecosystem condition and services assessment methodology at the local level.

The present pilot study tried to apply the National Methodological Framework to assess the condition of Oriental beech (*Fagus orientalis* Lypski) ecosystems. The Oriental beech is naturally distributed in the Balkans and its area in Bulgaria covers almost entirely the territory of the Strandzha Mountain (SE Bulgaria), which is the best preserved European broadleaved complex of the typical for the end of the Tertiary forests with an undergrowth of evergreen shrubs.

Material and methods

The Beech woodland in Strandzha Mt. belongs to G1.6 subtype of the High deciduous forest types (Barbati et al. 2006). The main methodological approach used in this preliminary study was the indicator approach including the measurement of a set of relevant indicators. The field studies were carried out on 6 pre-set Research Plots (RPs) in 2016. The ecosystems condition was assessed using different structural and functional indicators (see Table 1). Available data on the disturbance regimes, including fires, significant snow and wind breaks and falls, were used together with data on biotic damages by insects, animals and diseases from a former research (Georgieva et al. 2012). Different parameters of plant diversity (species composition, plant dynamics phase and grass cover) were used as indicators for assessing biotic heterogeneity. The degrees of defoliation and discoloration were used as indicators for stand condition and "health".

The number of woody structures (social class) of eastern beech stands was assessed as an indicator of the habitats diversity. The studied stands are grouped in four types, depending on the composition of the sub-floor (grass and shrubs cover).

As an indicator of the state of forest ecosystems characterizing ecosystem processes, the stocking index of the forest stands has been assessed.

The regeneration potential of the oriental beech as an important process related to the resilience of the ecosystem was assessed using the quantity of the seedlings and samplings in the research plots. The amount of the seedlings and saplings of the studied species was estimated using linear transects (4 x 10 m^2) and the observed individuals were divided into size classes.

The real values (parameters) of the used indicators were scored from 1 (indicating poor condition) to 5 (indicating very good condition). In order to collate all separate indicator scores into one single measure of the ecosystem structural-functional condition, the introduced in the National Methodological Framework IP index (Index of Performance) (MetEcosMap 2017) was calculated, as follows

$\mathbf{IP} = \sum ni / \sum ni_{(max)}$

(where: $\sum \mathbf{ni}$ – sum of the scores, assigned to every indicator; $\sum \mathbf{ni}_{(max)}$ – sum of the maximum possible score (score 5) for every indicator).

Results

The structural and functional indicators recommended in the National Methodological Framework were assessed using both available and measured data (Table 1).

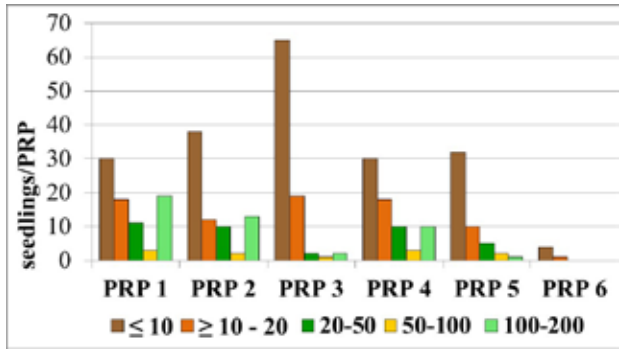

Fig. 1. Density of seedlings (number/m^2 and height in cm) of Oriental beech in the studied research plots (RP).

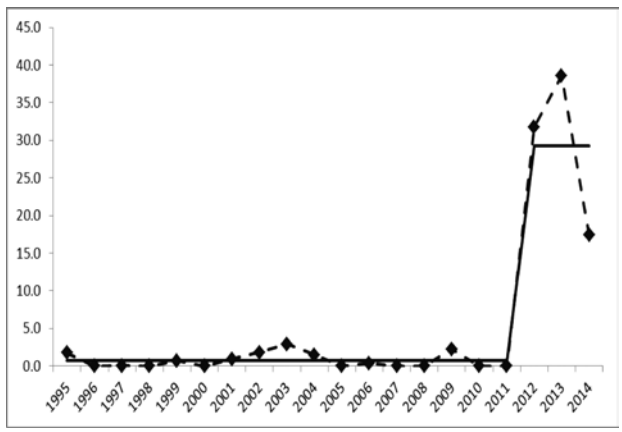

Fig.2. Regime shift (solid line) with shift point at 2011 in the dynamics of abiotic damage (% area) (dashed line) of broadleaved forests for 20 years period in Strandzha Mountain (p=0.005).

With respect to soil heterogeneity, the studied ecosystems showed little diversity. The soils were not eroded or erosion processes were at initial stage. The soils in the studied ecosystems were medium-rich to rich, moist and highly fertile.

The assessment of the parameters characterizing the plant diversity of oriental beech ecosystems showed that the stands were at their optimum age and in good condition. The evaluation of the other indicators of biotic diversity also indicated a relatively good condition. The degree of defoliation of all surveyed trees at the RPs varied between 35% and 55%, which defined them as being in a moderately good "health".

Significant differences were found when assessing the composition and coverage of the grassy and undergrowth cover. The coverage has a significant impact on other ecosystem condition parameters, especially the regeneration processes. The quantity of seedlings and samplings on the individual RPs varied

from almost complete lack of seedlings in RP6 to a satisfactory quantity in RPs 1-4 (Fig. 1). At RP6 the cover of Strandzha periwinkle (*Rhododendron ponticum* L.) was 100% and this prevents the normal development of the undergrowth. On the other hand, even mature, the forest stands have not yet entered the regeneration phase. For the particular tree species this is about 150-160 years. The main quantity of seedlings at all RPs was concentrated in the first two height classes - between 10 and 20 cm. This suggested that the stands were in the initial phase of tree regeneration process and that the studied ecosystems had a good regeneration potential.

An instructive finding, related to climate change, was the presence of damages caused by extreme events in all the studied plots. In some of the surveyed tree stands, the degree of damage exceeded 20%. The dynamics of the abiotic damages, together with the dynamics of other abiotic and biotic parameters, occurring in the broadleaved forests in Strandzha Mt. for 20 years period were studied previously (Georgieva et al. 2012). The presence of a significant shift in the regime of the abiotic damages was established (using the method of Rodionov 2004) - Fig. 2. This shift was more or less correlated with a number of biotic damages such as insects, animals and diseases.

Depending on the measured/assessed values (parameters) of the separate indicators score were assigned to the indicator which reflects the "condition" of the indicated structural or functional component of the ecosystem (Table 1). The scores indicated the condition of the corresponding structural or functional component. According to the assessed indicators the studied ecosystem of the Oriental beech in Strandzha Mt. was in an overall good ecological condition.

The Index of Performance (IP) which collates the separate indicator scores into one integral measure of ecosystem structural-functional condition was also calculated. The IP index for the separate RP varied between 73% and 86% (Table 1).

Discussion

The theoretical and methodological approach developed in the National Methodological Framework (MetEcosMap 2017) proved applicable for assessing

Table 1. Indicator assessment scores of ecosystem condition (1 – bag condition to 5 – good condition) and calculated IP values for the separate research plots (RP).

Indicator type	Indicator group	Indicator	Measure	Scores					
				RP 1	RP 2	RP 3	RP 4	RP 5	RP 6
Structural	Abiotic	Soil heterogeneity	erosion degree	5	5	5	4	4	5
			soil condition	3	3	4	4	3	3
		Geomorphology	slope	4	3	2	2	3	2
		Disturbance regime	fire regime	5	5	4	5	5	5
			wind and snow breaks and falls	1	1	1	1	1	1
	Biotic	Plant diversity	species composition	5	5	4	4	4	5
			stand dynamic phase	5	5	4	5	5	5
			grass cover	4	1	2	5	5	1
		Habitat diversity	even aged uneven aged	5	5	3	4	4	5
			Fragmentation	5	5	5	5	5	5
		Other biotic heterogeneity indicators	general stand condition	3	4	4	4	4	4
			forest health condition	3	3	3	3	3	3
Functional	Matter flow	Matter storage	stocking index	5	5	5	5	5	5
	Regeneration	Number seedlings	items/m^2	4	3	4	3	3	1
IP				**0.73**	**0.77**	**0.86**	**0.78**	**0.78**	**0.75**

the condition of ecosystems on a local scale and provide the necessary information concerning their ability to preserve potential for delivering ecosystem services. Gaps in the data sets and lack of time series data on some important condition indicators for the Oriental beech ecosystem were the main constrains in the assessment process. Poor availability of systematic data was found for some important indicators, i.e. impacts of pressures on biodiversity, such as pollution, climate change and invasive alien species.

As a whole, the developed National approach for assessment the condition of ecosystems presented a satisfactory *ad hoc* picture of the present state of the Oriental beech ecosystems. The main conclusion to emerge was that in Strandzha Mt. these ecosystems were in a good structural-functional condition and had a good regeneration potential. The IP index further indicated a well preserved capacity of the Oriental beech ecosystems to provide ecosystem services.

The challenges faced during the ecosystem condition and services assessment at the local scale studied highlighted the importance of incorporating knowledge on interactions between ecosystems in the National Methodological Framework as the basis of ecosystem services management.

Acknowledgements: This case study was partly supported by the Program for career development of young scientists, BAS.

References

Barbati A., Corona P. & Marchetti M. 2006. European Forest Types. EEA Technical Report: European Environmental Agency. 118 pp.

EC (European Commission) 2011. Communication from the Commission to the European Parliament, the Council, the Economic and Social Committee and the Committee of the Regions 'Our life insurance, our natural capital: an EU biodiversity strategy to 2020. COM (2011) 244 final, 3.5.2011)'. http://eurlex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2011:0244:FIN:EN:PDF (last assessed 15.05.2017)

Georgieva G., Bratanova-Doncheva Sv. & Chipev N. 2012. Assessment of the condition and occurred changes in typical forest ecosystems within the Natural Park „Strandzha". In: Mejdunarodna konferenzia "15 godini spisanie Balkanska Ekologia", pp. 32-37. (In Bulgarian)

Maes J., Liquete C., Teller, A., Erhard, M., Paracchini, M. L., Barredo, J., Grizzeti B., Cardoso A., Somma F., Petersen J., Meiner A., Gelabert E., Kristensen P., Bastrup-Birk A., Biala K., Pirrodi C., Egoha B., Degeorges P., Fiorin C., Santo-Martines F., Verboven J., Pereira H., Bengtson J., Gocheva K., Marta-Pedrosok C. & Snäll T. 2016. Mapping and assessing the condition of Europe's ecosystems: Progress and challenges. Technical report: European Union. 184 pp.

MetEcosMap 2017. Draft methodological framework for mapping and assessment of ecosystem services. http://bg03.moew.government.bg/node/296 (last assessed 15.05.2017)

MEA (Millennium Ecosystem Assessment) 2005. Ecosystems and Human Well-Being: Synthesis. Washington: Island Press. 155 pp.

Newbold T., Hudson L. N., Hill S. L., Contu S., Lysenko I. & Senior R. A. 2015. Global effects of land use on local terrestrial biodiversity. Nature: 45-50.

Rodionov S. 2004. A sequential algorithm for testing climate regime shifts. Geophysical Research Letters 31 (9): 1-4.