FOLIA OECOLOGICA – vol. 37, no. 1 (2010). ISSN 1336-5266

The changes in the values of ecological-stabilization functional potentials of forests in the model area Český les

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Abstract

Fialová, J., Vyskot, I. 2010. The changes in the values of ecological-stabilization functional potentials of forests in the model area Český les. *Folia oecol.*, 37: 16–22.

The aim of the work was to quantify the ecological-stabilization forest function by the method of Vyskot et al. (2003). The importance of living forests for sustainable development was discussed on many ministerial conferences. If we preserve forests, we will preserve life. Our study was pursued in a model area – a part of the protected landscape area Český les. The objective was to evaluate the real potentials of ecological-stabilization forest function and to see how these potentials are distributed in the individual forest management intervals. According to these results, we can discuss the previous management in the area. Both nature conservation and forest function needs require the quantification in both aspects. For the zones with declared protection, the needs of nature conservation have been defined, but the forest functions-related ones have not been included. The map of the distribution of real potentials for evolving ecological-stabilization forest function has been created.

Key words

declared zones of the nature conservation, forest management interval, forest stands, protected landscape area

Introduction

The purpose of our work was to analyse the nature protection needs and the society needs in forests ecosystems. Forests are a crucially important part of the environment. A considerable part of Czech forests is situated in protected areas. These areas are specified by the act Nr. 114/1992 Col., about the landscape and nature conservation. The whole forested area in the existing protected areas makes about 26.5% of the whole forested area in the Czech Republic. The research was carried out in the model area, within the Český les protected landscape area. The basic question were: which forest management intervals (20 years long periods) have the highest potential values for evolving ecological-stabilization forest functions and in what a way the forest management in last years can be discussed. The forest function potentials were evaluated for every forest stand of this type. The real potential of forest functions is quantified as the functional potential of forests (values of production functions) under optimum ecosystem conditions. The forest functions are controlled by effects of natural and ecosystem processes occurring in the forests.

Despite many centuries of human influence on forests, they have remained one of the best preserved components of nature and landscape, and as such, they are worth of corresponding attention within nature conservation. The forests covering one third of the Czech Republic area represent a considerable natural environmental potential for the landscape. If they are in the condition close to natural, they only need a minimum additional energy input. This holds even for forests managed for a rather long time. The necessity to preserve forests less affected by forest management, especially forests with their species composition close to the natural and forests with prevailing non-timber functions was responded by declaring the specially protected areas. The intensity of nature conservation significantly varies across these areas. The most of the surface is covered by third-zone forests for which general growing principles for commercial forests are usually sufficient. As for the existing nature conservation law, all forests, as an important landscape element, have granted with a general protection, however, without any special requirements on forest praxis.

As for the provisions of the nature and landscape conservation law, it is forbidden to manage national parks, 1st and 2nd zones of protected landscape areas, national natural reserves and natural reserves in a way requiring intensive technologies, especially means and activities that could cause considerable changes in the eco-system biodiversity, composition and function, or irreversible damage to the soil cover – as using biocides, changing water regime or carrying out extensive landscaping. The society admits that forests are special belongings supplying a number of additional benefits – apart from wood production; on the other hand, forest owners get no compensation for providing these functions. Decision on leaving the forests to their spontaneous development must be a part of a long-term elaborated preservation management strategy and must also be executed with respect to the forest crop pattern and the protected area category. It should not be a creditable or appreciated decision but a coherent part of complex approach to the management of protected forest areas. Important tools given to the nature conservation authorities by the nature and landscape conservation legislation are Conservation Plans. It is important that drafts of these Conservation Plans must be negotiated with forest owners and administrators, thus providing space for communication and seeking for mutually viable solutions. Differentiated conservation of forest eco-systems in various categories of specially protected areas is specified upon the Conservation Plans. As mentioned earlier, the tools for differentiated use of national parks and protected landscape areas are zoning and Conservation Plans. Zoning is the essential background for Conservation Plan design. Goals of nature preservation are formulated in long-term, medium-term and short-term time horizons. Long-term goals correspond with the cycles usual in forest management (rotation period, physical age of the crop). Current forest management must shift the existing forest management towards to the nature-close ensuring more ecological stability and fulfilling all requested forest functions. Goals and ways are to define transparently and easy to understand. The present public order of forest conservation needs to include not only the requirements on production of an ecologically valuable source – wood mass, but also equally strong requirements on preservation and recovery of natural environment with natural bio-diversity, contribution to soil conservation, well-balanced water regime, fixing of CO_2 and providing recreational possibilities in aesthetically pleasing natural environment (Pelc and Moucha, 2008).

These requirements can only be defined upon the knowledge of authentic abilities of forest eco-systems in optimally possible eco-system conditions, i.e. with the knowledge of the real forest function potential and the value of total real potential of forest functions.

Many institutions, organisations and specialists advice of the need in evaluation and integration of forest functions to forest planning. They often refer to the revolutionary conferences and summits which progressively defined basic limits and principles. As an example we can mention Briales's approach (2003): "Integration of various functions into forest management can be evaluated whenever applicable indicators are available. These indicators must be applied to each forest unit and should be based on the resolution of the ministry conference concerning forest protection having taken place in Lisbon 1998. The indicators are homogenously combined into criteria. They can be applied in two possible ways: market possibilities with the aim to minimise expenses within sustainable development and the possibility of public incentives e.g. with the aim to create substitution products or benefits". Forest functions are naturally connected with the sustainable development (management) principle as proved by e.g. another research concentrating on multi-functional management of mountain forests: "Sustainable Forest Management and Certification" or "Multifunctional Mountain Forest Management" within the LIFE project (Pollini and Tosi, 2000). It results in adaptation of traditional forest management with the aim of technical development, improved cost effectiveness and respecting of typical forest crop composition and sustainability of forests fulfilling e.g. protective, production and recreation functions. However, sustainability of forest management with multi-functional goals has to be defined upon continual assessment of a number of indicators.

Olenderek et al. (1995) mention the possibilities and advantages of forest monitoring systems for the purpose of multi-functional forest management. They developed the system and conception which projects especially the principle and attitude to the forest multi-functionality that are beneficial. The project is dedicated to the development and information support of the system of use and tools of multi-functional forest management. Presently, forests are a place where many conflict situations arise. Those are for example the conflicts between the principles of forest use and the needs of forest protection and sustainable forest management.

It is also important that the sustainable development should provide the important functions (protective, economical and social) both today and in future on local, regional and global levels without causing a threat to other eco-systems (Mośnil, 1994 in Olenderek et al., 1995).

However, some authors such as Rykowski (1994) admit that evaluation of forest functions (abilities to fulfil forest functions) and their monitoring are very difficult. They agree on the need to separately quantify the functions and to set multiple criteria evaluation principles. They use the generally applied criteria and adapt the approaches for the conditions of Poland.

Olenderek et al. (1995) summarise partial conclusions and outcomes of their long-term research as follows: "Modern forestry must keep in mind the future and should therefore accept the need of stable forest existence. Multifunctional forestry was based on results and experience of many generations of foresters. However, new theories, tools and applications should be used more extensively at present. Complex monitoring and forest evaluation is one of these tools".

Material and methods

For the evaluation of forest function real potentials in the model area, the ecosystem method Vyskot et al. (2003) was chosen. The so called all-society forest functions are evaluated in the ecosystem units with the interaction with the forest partition (Vyskot et al., 2003). This method evaluates 6 groups of forest functions: bioproduction, ecological-stabilization, edaphic-soil conservation, hydric-water management, sanitary-hygienic and social-recreational forest functions (Fig. 1). In this work the ecological-stabilization forest function was evaluated. Natural and implemented all-society functions of forests are determined by synergetic effects of the spectrum of elements and segments of a forest ecosystem. Ecosystem functional parameters of the ecosystem elements and segments or their interacted or additive aggregations form determination criteria of functions. They are divided according to the type of source and processing as follows:

Direct parameters are documented in data and overviews of the forest management plans database of the CR forests (characterizing particular defined forest units). Indirect parameters are documented by other database sources (different hierarchical level of site and application units).

Ecological-stabilization potential is quantified as the maximum possible functional capacity of forest ecosystems (value of the production function) necessary for maintaining balance in energo-material flows under optimum ecosystem conditions, and controlling self-regulation processes and resistance to disturbances. Real species composition is the direct criterion for the ecological-stabilization forest function. With increasing species diversity, ecological stability of the stand also increases. Natural communities showing high ecological stability despite low biodiversity are an exception. A rich species composition enables more interactions among the ecosystem functions. Monocultures and more or less pure types are more prone to damage by abiotic and biotic agents.

Degree of naturalness of a stand type – as an indirect criterion expresses to what extent the real species composition corresponds to the site conditions. With the increasing degree of naturalness, the self-regulation potential of the stand is improved as well as its resistance to stress factors. The degree of the stand type naturalness is determined through the relationship of the real species composition to the natural species composition corresponding to the real natural conditions (Table 1).

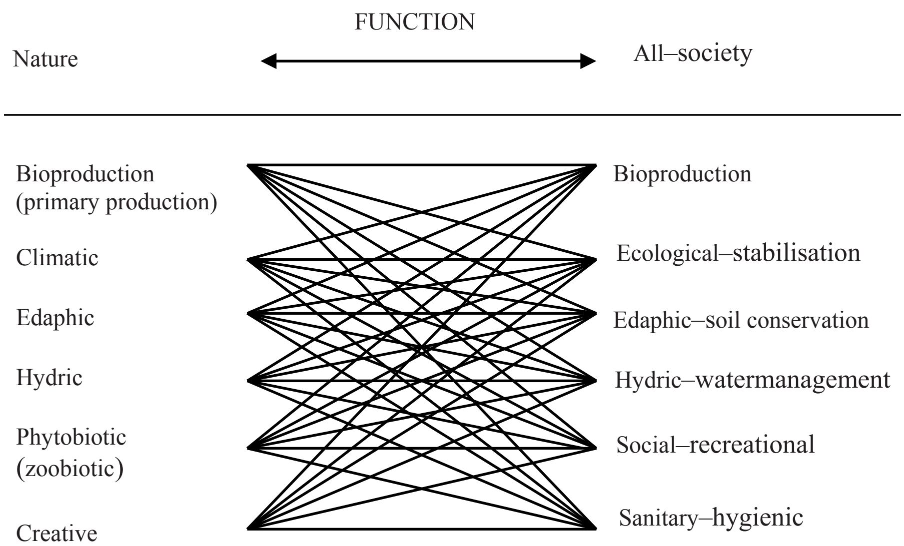

Fig. 1. Effectiveness groups of all-society functions of forests on the basis of ecosystem function synergies (Vyskot et al., 2003)

The data we used for the quantitative evaluation non-wood benefits forest function were taken from forest management plans. In the Czech Republic, forest management plans are designed at 10-year intervals. For our purposes we needed the data on the stand type and functional target management group.

For ecological-stabilization forest function is also important the stand age. Stand types are species schemes created according to the proportion of the particulate species in the stand composition. Functional target management group specifies related higher practical units of forest ecosystem types of the real species composition characterized by limits on natural conditions.

Value classification of real potentials of forest functions goes from 0 (functional unsuitable) to 6 (extraordinary).

The map of the real potentials patterns of ecological-stabilization forest function was created in the ArcGIS 9.2. In this software the data analysis was processed. By the database task were the stands assorted according to the age of forests into the proper interval. The length of the forest management interval is 20

Table 1. Example of the real potentials value degree for 3 chosen forest functions (Vyskot et al., 2003)

45	BP	ES			HV						
Stand type	RP Ø	Species diversity	Natural composition	RP Ø	Horizontal precipitation	Potential infiltration	Potential runoff	Interception	Evapotranspiration	Soil permeability	RP Ø
C1	5	0	1	1	0	0	0	2	1	4	2
D1	5	1	2	2	0	0	0	2	1	4	2
M1P3	4	2	3	3	0	0	0	2	1	4	2
D1P3	4	1	2	2	0	0	0	2	1	4	2
C6	5	0	5	3	0	2	0	4	0	4	2
M1P5	5	2	3	3	0	0	0	2	1	4	2

45, functional target management group; BP, bioproduction forest function; ES, ecological-stabilisation forest function; HV, hydric-watermanagement forest function; C1, pure spruce stand type; D6, mixed stand type with the „dominant“ proportion of beech; M1P3, mixed stand type of spruce and admixed pine; D1P3, mixed stand type with the dominant proportion of spruce and admixed pine; C6, pure beech stand type; M1P5, mixed stand type of spruce and admixed oak; RP Ø, average value of real potential.

Value degrees of real potentials: 0 – functionally unsuitable, 1 – very low, 2 – low, 3 – average, 4 – high, 5 – very high, 6 – extraordinary.

Fig. 2. The map print of the time management interval on the model area Český les

I. 1 – 20 II. 21– 40 III. 41 – 60 IV. 61 – 80 V. 81 – 100 VI. 101 – 120 VII. 121 – 140 VIII. 141 – 160 IX. 161 – 180 X. 181 – 200 years (intervals 1–20, 21–40, 41–60 etc., Fig. 2). After this analysis we analysed the distribution of the ecological-stabilization forest function potentials in the forest management interval. The extent of the unit classification of potentials in different forest management interval was found out and the percentage representation. On the basis of these results we are able to discuss the previous forest management. How the values of the ecological-stabilization forest function were projected in the forest management plans and how the harvesting was focused.

Results and discussion

There were analysed 662.4 ha of forests in the Český les. The values of real potentials of ecological-stabilization forest function were quantified and the surface and percentage distribution of forest in the real potential values classes was established.

For the quantitative evaluation of forest´s point of view, the maps made in GIS have the most important predicative worth. In the Fig. 3, one can see the distribution of real potential values (ecological-stabilization forest function).

The results of evaluation were analyzed, and the distribution of the highest value of real potentials in the age classes (20 years period) was determined. The results of this analysis are shown in the Table 2.

The highest achieved value of the real potential of ecological-stabilization potential of forest function is 5, so the very high. The highest percentage surface cover of the very high ecological-stabilization potential of forest function is in the I. and in the VII. forest management interval. The ecological ecosystem approach in the last twenty years has been projected in this very high real potential of ecological-stabilization forest function and that the management was influenced, and still is, by this approach. Very interesting results were obtained in the IX. forest management interval. The achieved value of ecological-stabilization potential of forest function is 1 (very low), and the stands with this value in IX. forest management interval cover 100%.

The positive result is that some parts of stands in the I., II., III., IV., V. and VII. forest management interval have attained the very high ecological-stabilization potential of forest function (value 5). The needs of nature conservation are defined in the forest management plan, but the forest functions are not included in the declaration procedure. For the comparison of ecological-stabilization forest function real potentials distribution and declared zones of nature conservation distribution the Fig. 4 is enclosed.

For the synergy of nature conservation and forest function need`s detection is it necessary to quantify both of them. It was necessary to interconnect known aspects of the nature conservation (projected in the zonation) with the forest function quantification. The suggestion whether the nature conservation needs are in the conjuction with the high functional potentials of forests was very important. If we compare the map of declared zones of the nature conservation and the map of the real potentials of ecological-stabilisation forest function, the results is that the contemporary zonation is really one-sided and does not respect the parallel side-run of the nature conservation needs and forest function needs.

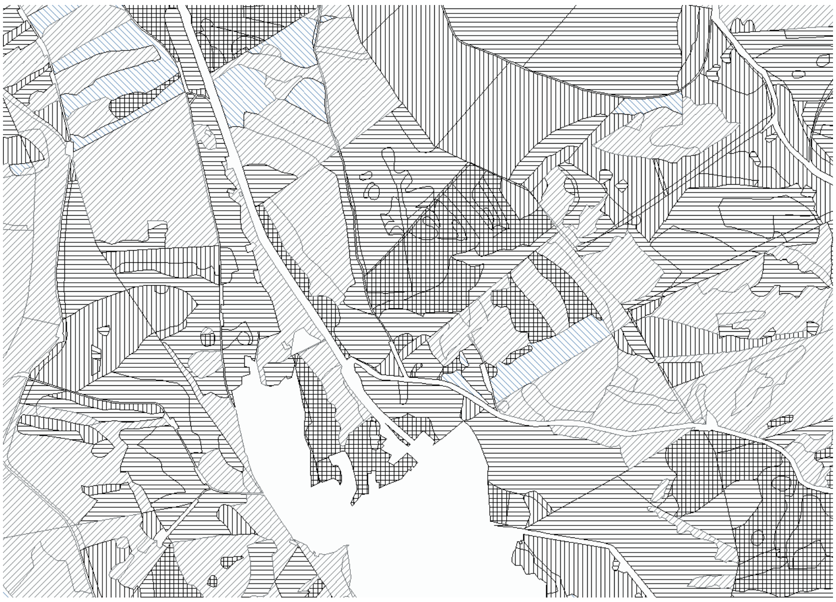

Fig. 3. The map print of real potential of ecological-stabilization forest function on the model area Český les
Value degree 0 Value degree 1 Value degree 2 Value degree 3
Value degree 4 Value degree 5 Value degree 6

These results do not follow the ideas of Briales (2003), Olendrek et al. (1995) or Rykowski (1994). We should implement these ideas in the law of the Czech Republic, not only in the forest law but in the nature protection law as well.

Conclusion

The area of 662.4 ha was analyzed and the real potentials of ecological-stabilization forest function were found out. A GIS distribution map was created and the analysis of the highest real potential in the age classes was made. We can say that the ecological ecosystem approach in the last twenty years has been projected in a very high real potential of ecological-stabilization forest function and that the management was influenced and still is, by this approach.

Acknowledgement

The study has been supported by Research plan of the Faculty of Forestry and Wood Technology Mendel University in Brno – MSM 6215648902 and the project VaV Sp-2d3-56-07 „Ecological and economic evaluation of social functions of alternatively structural forests“.

Table 2. The distribution of the highest value of ecological-stabilization real potentials in the management time interval (interval of forest age)

Management time interval	Area of the management time interval in ha	The highest value of ecological-stabilisation real potential	Part of surface with the highest value of real potential in the management time interval [%]
I. (age 1–20)	341.4	5	18
II. (age 21–40)	6.3	5	6
III. (age 41–60)	34.8	5	2
IV. (age 61–80)	31.1	5	9
V. (age 81–100)	121.5	5	2
VI. (age 101–120)	12.4	3	67
VII. (age 121–140)	69.9	5	25
VIII. (age 141–160)	17.7	4	19
IX. (age 161–180)	9.4	1	100
X. (age 181–200)	17.9	3	46

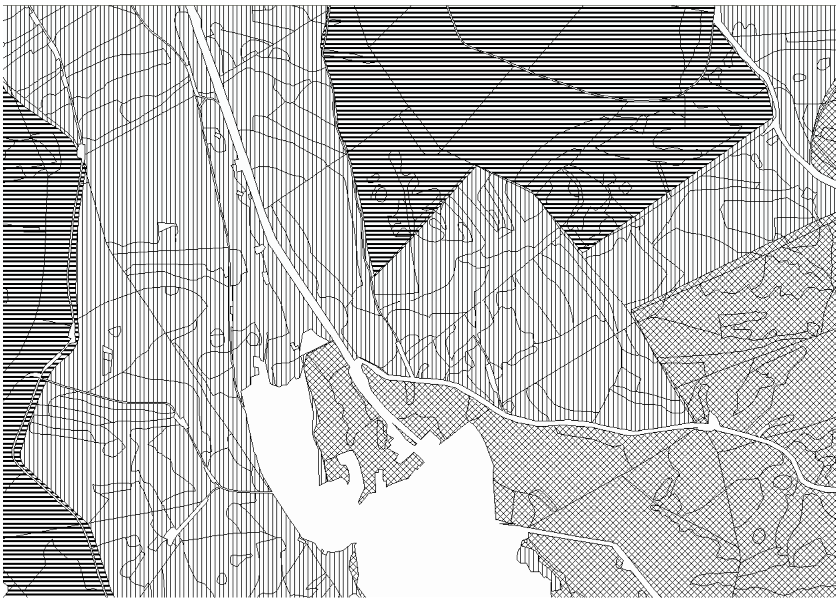

Fig. 4. The map print of the declared zones of the nature conservation (Český les protected landscape area)

1st zone 2nd zone 3rd zone

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Změny v hodnotách reálných potenciálů ekologicko-stabilizační funkce lesů na příkladu modelového území Český les

Souhrn

Cílem práce bylo kvantifikovat ekologicko-stabilizační funkci lesů metodou Vyskot a kol. (2003). Na mnohých ministerských konferencích o lesích byla diskutována důležitost živých lesů pro udržitelný rozvoj společnosti. Pokud budeme pečovat o lesy udržitelným způsobem, můžeme zajistit i trvalý život na Zemi. Pro práci bylo vybráno modelové území, kterým je nejjižnější část CHKO Český les. Cílem práce bylo nejen hodnocení funkcí lesů, ale také zjištění, jak jsou hodnoty reálných potenciálů distribuovány v rámci stanovených časových intervalů managementu (délka intervalu je 20 let). V závislosti na těchto výsledcích můžeme diskutovat předchozí management uplatňovaný v území a přístup společnosti k ochraně životodárných lesů. Bylo analyzováno území o rozloze 662,4 ha a vyhodnoceny reálné potenciály ekologicko-stabilizační funkce lesů. V prostředí GIS byla vyhotovena mapa distribuce hodnot reálných potenciálů této funkce a pomocí databázových dotazů byla provedena analýza zastoupení jednotlivých hodnot reálných potenciálů v časových intervalech managementu. Můžeme na základě výsledků říci, že ekologický ekosystémový přístup k životnímu prostředí uplatňovaný v posledních dvaceti letech je promítnut do vysokých hodnot reálných potenciálů ekologicko-stabilizační funkce lesů a že management byl velmi ovlivněn a stale tímto přístupem pozitivně ovlivněn je. Práce je podložena hodnocením pomocí objektivní ekosystémové metody uznané Ministerstvem životního prostředí ČR. Porovnání reálných účinků lesů, tedy reálných funkčních potenciálů lesů, se stavem porostů na území CHKO je v současnosti jedinou prací, která se touto problematikou zabývá.

Received December 14, 2009
Accepted June 3, 2010