JOURNAL OF FOREST SCIENCE, *48*, 2002 (5): 230–236

Risks of the wood-producing function of forests in areas with the special statute of protection

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ABSTRACT: Fulfilling the wood-producing function of forests can be understood as a removal of wood mass by logging operations from the forest environment usually for the purpose of its commercial use. The activity can be implemented in all stages of forest development. Positive economic effects are usually expected. Management in specially protected areas requires to concentrate on the preferential fulfilment of protection objectives in affecting the forest ecosystem. In this context, the use of the wood-producing function of forests is often comprehended as controversial. But it has been proved that the maintenance of the forest condition corresponding to the ideas of fulfilment of protection objectives requires differentiated management, application of silvicultural as well as logging measures, viz. even in 'measure-free' zones. Many strategies of management for specially protected regions have been formulated, however, evaluation or quantification of risks of the activity from the aspect of danger and fulfilling the objective of protection is missing. The paper deals with this problem, plans the methodology of evaluation and quantification of risks of using the wood-producing function of forests in specially protected areas with a special statute of protection – areas falling under the NATURA 2000 directive. The quantification of risks and specification of the limiting values for evaluation of various technologies were studied by an expert method in 2000–2001 in eleven small-scale and large-scale protected areas in the Czech Republic.

Keywords: specially protected areas; wood-producing function; risk of use

In the Czech Republic, there are 4 national parks (area of 111.6 ha, i.e. 1.4% of the Czech Republic's territory) and 24 protected landscape areas (area of 1,041.6 thousand ha, i.e. 13.2% of the Czech Republic's territory) within large-area specially protected areas (as established by Act No. 114/1992); within small-area specially protected areas there are 1997 units (different statute of protection and size) representing 86.3 thousand ha, i.e. 1.0% of the CR territory. The areas are under special protection concerning the restriction of the wood-producing function of forests. The limitation of the wood-producing function of forests is also applied in a substantial part of the CR forests (logically in areas intended for fulfilling the function of forests in terms of Act No. 289/1996) representing 22.3% of the area of forests in the category of protection forests and special-purpose forests. Although it is evident that both examples mentioned above frequently overlap, in the category of specially protected areas there is a part of the territory (about 30%) out of the land intended for fulfilling the functions of forests and it would be possible to mention also other aspects, it is obvious that the areas where the wood-producing function is legally limited are extensive, very differentiated and distributed throughout the territory of the country. Moreover, it is evident that in accordance with the fulfilment of the principles of the NATURA 2000 programme, a certain part of forests not negligible from the viewpoint of area fulfilling the wood-producing function of forests will be distinguished without other than legal restrictions (CHYTRÝ et al. 2001). If the above-mentioned facts are a prerequisite for our accession to the EU in the near future, it is necessary to take into account the fulfilment of the wood-producing function of forests and to deal with related questions. The matters are put into the foreground if we take into consideration that we unambiguously belong to countries with the smallest average area of private property in Europe and that the realized cuts do not reach harvesting potentials according to domestic and European experts.

WOOD-PRODUCING FUNCTION OF FORESTS IN SPECIALLY PROTECTED AREAS

Fulfilment of the wood-producing function of forests can be understood as a removal of wood mass (through logging operations) from the forest environment, usually for the purpose of its commercial use. The activity can be realized in all stages of forest development and positive economic effects are usually expected.

The intensity of wood-producing function can range in extreme positions from an individual selection with the

minimum volume of harvested timber per unit area to the application of clear felling. To let the forest to its development without any felling measures represents rather an extreme position. In this case, however, it is not possible to speak about the use of the wood-producing function of forests.

In specially protected areas (defined by Act No. 114/1992) where the forest and the forest environment are influenced and thus the wood-producing function of forests is fulfilled, it is necessary to prefer the objectives that will ensure and stabilize the ecological function of forest ecosystems in accordance with differentially determined subjects of protection and management of their use. Fulfilling these objectives, the use of the wood-producing function is often understood as an antagonistic negative factor.

This attitude is not however correct because it is necessary to admit that special management in specially protected areas has to take into account (in order to ensure the objectives of protection) also silvicultural and regeneration measures where the wood-producing function is applied. It is evident from a number of publications (e.g. MÍCHAL et al. 1992; POLENO 1997; MÍCHAL, PETŘÍČEK 1999; PRŮŠA 2001, etc.), methodology of preparing the plans of care of specially protected areas takes it into account (KOLEKTIV 1999), it is also reflected in legislation. The use of particular technologies and risks of their application from the viewpoint of achieving the objectives of protection have not been discussed or rough empiricism is used. For these reasons, the VaV/610/2/00 project *Determination of limits and assessment of risks of the wood-producing function of forests in specially protected areas according to the category of protection* was solved within the CR Ministry of Environment assignment in 2000–2001. The project objective was to prepare basic methodologies for the potential quantification of risks of the wood-producing function of forests in specially protected areas, generally in a prospect for areas with the special statute of protection. The resulting methodology is presented in this paper.

SYSTEM ANALYSIS OF RISKS OF THE WOOD-PRODUCING FUNCTION OF FORESTS IN SPECIALLY PROTECTED AREAS

The quantification of the wood-producing function of forests from the viewpoint of achieving the objective of protection is dealt with in the following scheme:

Degree of risk (*DR*) – basic value 1–100

Potential limitation of achievement (or preservation) of the objective of protection and its extent

0	no	risk factor has no effect on achievement of the objective of protection	1
1	small	by materializing the effect of a risk factor the objective of protection is not endangered or its achievement is not worsened	10
2	medium	by materializing the effect of a risk factor the objective of protection is not endangered, however, its achievement is more difficult	20
3	large	by materializing the effect of a risk factor the objective of protection is endangered, its achievement is challenging but realistic	50
4	extraordinarily large	by materializing the effect of a risk factor the objective of protection is endangered, its achievement is often unrealistic	80
5	extreme	the materialization of the effect of a risk factor cannot be prevented, achievement of the objective of protection is not realistic	100

The conception of a comprehensive risk of irreversible changes in the forest ecosystem destruction is also introduced.

Risk materialization (*RM*) – weight 1–10

1	minimum, zero	weight	1
2	realistic, unexpectable	weight	3
3	realistic, significant	weight	7
4	sure	weight	10

Effects of the risk materialization (*ERM*) – weight 1–10

Time aspects of the effect of risk materialization from the viewpoint of maintenance (restoration) of the objective of protection

1	short-term	weight	1
2	temporary	weight	5
3	permanent	weight	10

Quantification of risks (*QR*)

Quantification of a particular risk

$QR_i = (DR \,.\, RM \,.\, ERM) + CUR,$

CUR – coefficient of unpredictable risk – (0–100)

Quantification of the total risk of technology use

$$QTR = a \,.\, b \,.\, c \,.\sum_{i=1}^{n} QR_i$$

where: *a* – coefficient of a potential failure to observe optimum logging and hauling technology (1–10),

b – coefficient of the degree of protection regime as related to the zones of differentiated protection (1–4),

c – coefficient of the degree of natural character of forest stands (2–10).

The use of technologies with respect to fulfilling the objective of protection

– acceptable (exploitable),
– problematic,
– unacceptable (unrecommendable).

(Quantification on the basis of research results).

Economic evaluation

Management result:

– positive +
– balanced ±
– negative –

The scheme shows the basic methodology for the quantification of risks and classification and evaluation of actual technologies proposed for particular areas. The solution, i.e. evaluation of the technology aimed at the use of the wood-producing function of forests in accordance with the given objective of protection, is implemented in the following successive steps:

– area classification, area categorization for basic management strategies
– specification of the protection objectives for parts of the area with particular management strategies,

I	required condition, 'measure-free' regime, individual special-purpose selection only
II	possibility of gradual achievement of the target condition in a long-time horizon based on the use of silvicultural and logging measures, utilizable
III	unrealistic achievement of the required condition, reconstruction, conversions

– definition of the optimized silvicultural or regeneration procedures,
– simulation of the development of stands using a growth simulator according to PRETZSCH and SEIFERT (1999) and ĎURSKÝ (1999) for selected silvicultural or regeneration procedures aimed at the verification of fulfilling the objective of protection,
– the proposal of technology variants including economic evaluation,
– risk quantification in a scheme given in Table 1 for assessment of particular risks and with the following limits for assessment of total risk of the use of logging technology:
– technology is utilizable without problems if $QTR / 100 < 300$ and the case if $QR > 1{,}400$ does not incur any risk;
– technology is utilizable if $QR > 5{,}600$ does not incur any risk (at the same value of QTR / 1,000). In this case, it is necessary to assess risks from the potential failure of logging technology;

Table 1. General scheme of the quantification of risks of the wood-producing function in specially protected areas in relation to fulfilling the objective of protection

Risk	Relationship to management strategies* (I, II, III)	Relationship to fulfilling the protection objective	Limits of use (*QR*)		
			acceptable	problematic	unacceptable
Comprehensive risk of irreversible destruction of forest ecosystem	I, II	bound			
Soil damage, erosion, damage to orographically important parts and components	I, II, III	bound			
Disturbance of the soil water regime with hardly predictable impacts	I, II, III	bound			
Origin of open areas with specific microclimate of unstocked area	III (II)	free	< 1,400	1,400–5,600	> 5,600
Changes in the internal relations of forest community with hardly determinable prediction	I, II	influencing			
Extinction of ecological niches of plants and animals, damage to or destruction of protected species	I, II, III	bound			
Damage to tree stems and crowns in various stand storeys, increased disposition to the attack of biotic agents, removal of natural regeneration	I, II	influencing			
Damage to tree stems and crowns in various stand storeys, increased disposition to the attack of biotic agents, removal of natural regeneration	I, II	influencing			
Opening the stand walls, opening-up of the canopy, increased disposition to damage by abiotic and biotic agents	III, II (I)	influencing			
The complex of risks from the realization of management activities and use of means of mechanization	I, II, III	influencing			
Unspecified social risks resulting from the use of the wood-producing function in specially protected regions	I (II)	free			

*Areas with management strategy when risk assessment is preferential with respect to potential technologies

– technology where $300 < QTR / 1{,}000 < 1{,}300$ is evaluated as problematic, however utilizable in justified cases and at the same time $QR < 5{,}600$ for all values of a defined risk;
– technology where $QTR / 1{,}000 > 1{,}300$ cannot be assessed as recommendable.

Quantification of risks is carried out by an expert method in the following steps:
– empirical assessment of values and coefficients for the basic computational scheme,
– calculation of values of particular risks and of total risk for a broader spectrum of areas within the CR (SIMON et al. 2001),
– evaluation of the use of technologies by a group of experts and classification into categories: acceptable, problematic, unacceptable,
– specifying the limit assessments of risks.

VERIFICATION OF THE METHODOLOGY OF RISK QUANTIFICATION IN USING THE WOOD-PRODUCING FUNCTION OF FORESTS IN SPECIALLY PROTECTED AREAS

The methodology was studied and tested in 11 small-scale and large-scale areas in the CR within the VAV/610/2/00 Project *Determination of limits and assessment of risks of the wood-producing function of forests in specially protected areas according to the category of protection* (SIMON et al. 2001). The project was included in research plans of the Faculty of Forestry and Wood Technology, University of Agriculture and Forestry, Brno (MSM 434100005). Quantification of total risk for regions with different management strategies in particular areas is given in Fig. 1, an example of determination for the Praděd National Nature Reserve (the Jeseníky Protected Landscape Area) is presented in the following Fig. 1.

THE JESENÍKY PROTECTED LANDSCAPE AREA (NATIONAL NATURE RESERVE PRADĚD)

Areas with management strategy I

– Logging and hauling technologies
Individual selection of trees for the purpose of releasing the natural regeneration. Directional felling using a power saw, leaving wood in the locality.
– Risks of the wood-producing function
Comprehensive risk of irreversible destruction of an ecosystem
$QR = (80 \,.\, 10 \,.\, 5) + 80 = 4{,}080$
quantification of total risk

$$\sum_{i=1}^{n} QR_i = 4{,}080$$

$QTR = 5 \,.\, 4 \,.\, 10 \,.\, 4{,}080 = 816{,}000$

Areas with management strategy I/II

– Logging and hauling technologies
Individual and group selection, cutting with power saw, directional felling. Horse skidding. Leaving dry wood in the locality.
– Risks of the wood-producing function
damage to crowns, rubbing off the tree stems

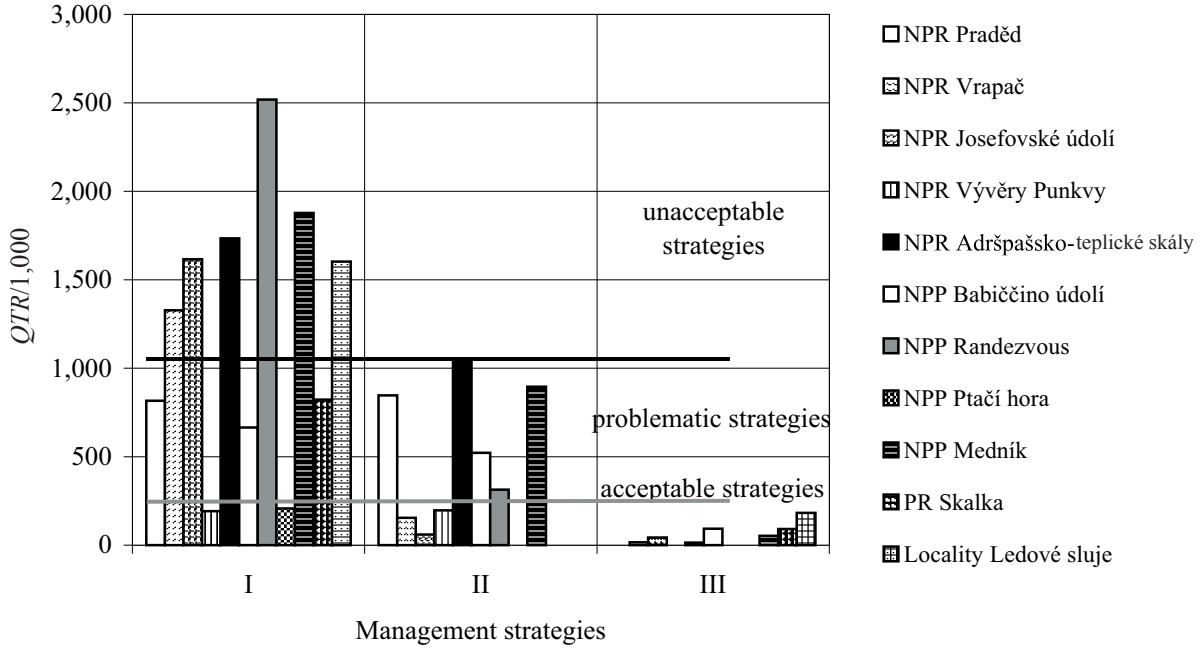

Fig. 1. General scheme of quantification of the total risk of using the wood-producing function in particularly protected areas as related to the management strategy

QR = (20 . 3 . 5) = 300
thinning the stands, increased disposition to damage by abiotic agents
QR = (50 . 7 . 5) + 30 =1,780
increased danger of damage by biotic agents (bark beetle) as a result of damage and physiological stress
QR = (20 . 7 . 5) + 10 = 710
removal of individual trees of the autochthonous ecotype of spruce
QR = (50 . 7 . 10) = 3,500
decreased capability to predict the development of stand components
QR = (10 . 3 . 1) + 50 = 80
general social risks resulting from the implementation of felling measures in specially protected areas
QR = (1 . 10 . 5) = 50
quantification of total risk

$$\sum_{i=1}^{n} QR_i = 6{,}420$$

QTR = 1 . 4 . 6 . 6,420 = 154,080

Areas with management strategy II

– Logging and hauling technologies
Clear felling with limits according to Act No. 289/1995, felling with power saw. Skidding – first a horse, then a cableway to a roadside landing.
– Risks of the wood-producing function
damage to the soil surface, introskeletal erosion
QR = (80 . 10 . 10) + 80 = 8,080
opening the stand walls, danger of destruction of neighbouring stands by combined effects
QR = (50 . 10 . 5) + 100 = 2,600
creation of clearings with the microclimatic phenomenon of an open area markedly complicating reforestation
QR = (50 . 10 . 5) + 50 = 2,550
changes in the original water regime with hardly predictable impacts
QR = (50 . 7 . 5) + 80 = 1,830
creation of the environment for game concentration after the origin of young plantations
QR = (50 . 10 . 5) + 10 = 2,510
general social risks resulting from logging carried out in specially protected areas
QR = (1 . 10 . 5) = 50
quantification of total risk

$$\sum_{i=1}^{n} QR_i = 17{,}620$$

QTR = 2 . 4 . 6 . 17,620 = 845,760

CONCLUSION

In deciding on the use of the wood-producing function of forests in specially protected areas it is necessary to take into consideration the following aspects:

Areas or regions included in management strategy I ('measure-free' regime), i.e. areas that are most suitable to fulfil the target idea, will frequently change during their self-development, frequently to communities considerably different from the target community. The use of the wood-producing function appears to be useful even there, however, it has to be supported by the long-term simulation of development in various strategies. Risks are high, economic effects usually considerably low, however, it is possible to keep permanently a target idea (condition).

Using the wood-producing function is justified and logic in areas or regions with management strategy II (possible conversion to the target idea of a community in a long-time horizon by suitable silvicultural practices). The long-term simulation of development based on various silvicultural strategies is necessary even there. The risk is generally adequate, economics of the measures is usually balanced and it concerns partly profits. With respect to the fact that the time horizon is long-term, attainment of the target vision of a community can however be complicated by natural and social effects. Changes in the view on the objective of protection rank among the effects.

In areas with management strategy III (not corresponding to the target idea), the use of the wood-producing function is logic and necessary. It is possible to apply even a more intensive approach there (clear felling, premature felling), decision-making is relevant in the field of technology in relation to the strategy of regeneration (reforestation). With respect to the facts it is possible to define risks that are usually adequate, risks concerning the breach of the protection objectives are minimal. Economic effects are usually favourable or balanced if we do not take into account potential production losses that are, however, balanced by the effort to achieve the objective of protection as quickly as possible.

In areas with management strategy I (e.g. protection of a species) it is generally very difficult to generalize the rate of risk, however, it is possible to state that it is considerable being extraordinarily related to the suitable choice of technological aspects and precise implementation. Economic effects are not usually positive as they largely depend on the structure of existing stands (management strategies I, II, III) because there is always an endeavour to create stands approaching the target idea of stands on a site. With respect to this aspect the use of the strategy can be considered as complicated.

Generally, it is possible to state that the structure of potential risks is very similar in the majority of the areas considerable differences being in their quantification which indicates the possibility to use proposed technologies.

Risk quantification and classification of using the wood-producing function are possible on the basis of the proposed scheme and method, however, we have to take into consideration that it is based on an expert method and, therefore, it is necessary to use comparative standards (e.g. actual risks of management outside specially protected areas under comparative conditions).

The use of the wood-producing function very often encounters legislative limits that have to be coped with.

Social risks of using the wood-producing function in specially protected areas appear to be a quite specific risk. The risk does not show an immediate effect on the objective of protection, however, in a social context it can often play an important role.

In principle, the only possibility of limiting the risks under condition of the choice of an optimum technology is its quite precise application.

Acknowledgement

The author is indebted to 29 collaborators for an extraordinary effort in studying the problems, particularly to Dr. ANTONÍN BUČEK from the Faculty of Forestry and Wood Technology, Mendel University of Agriculture and Forestry, Brno and to RNDr. STANISLAV VACEK, DrSc., Research Institute of Forestry and Game Management, Jíloviště-Strnady, Research Station Opočno for an assistance in studying the methodology of risk assessment.

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Received 25 March 2002

Rizika uplatnění produkční funkce lesů na územích se zvláštním statutem ochrany

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ABSTRAKT: Naplňování produkční funkce lesů lze chápat jako odebírání dřevní hmoty těžbou z lesního prostředí, obvykle za účelem jejího komerčního využití. Uvedenou činnost lze realizovat ve všech stadiích vývoje lesa; zpravidla se předpokládá pozitivní ekonomický efekt. Při hospodaření ve zvláště chráněných územích je nutné se obecně zaměřit při managementu ovlivňování lesního ekosystému na přednostní plnění cíle ochrany. V tomto kontextu bývá často uplatňování produkční funkce lesů chápáno jako kontroverzní. Lze však považovat za prokázané, že velmi často udržení stavu lesa, který odpovídá představám naplnění cíle ochrany, vyžaduje diferencovaný management, uplatnění pěstebních i těžebních zásahů, a to i v tzv. bezzásahových zónách. Strategií hospodaření pro zvláště chráněná území je formulováno mnoho, co ale chybí, je hodnocení, resp. kvantifikace rizik uvedené činnosti právě z pozice ohrožení, tj. plnění cíle ochrany. Příspěvek řeší právě uvedenou oblast, navrhuje metodiku hodnocení a kvantifikace rizik uplatňování produkční funkce lesů ve zvláště chráněných územích se zvláštním statutem ochrany; jde o území spadající do oblasti směrnice NATURA 2000. Kvantifikace rizik a vymezení mezních hodnot pro posouzení různých technologií bylo řešeno expertní metodou v letech 2000–2001 na jedenácti maloplošných a velkoplošných chráněných územích v ČR.

Klíčová slova: zvláště chráněná území; produkční funkce lesa; riziko uplatnění

Článek navrhuje metodiku hodnocení a kvantifikace rizik uplatňování produkční funkce lesů ve zvláště chráněných územích řešenou na jedenácti chráněných územích v České republice.

Kvantifikace celkového rizika uplatnění technologie (*KCR*) je kalkulována podle vztahu:

$$KCR = a \,.\, b \,.\, c \,.\sum_{i=1}^{n} KN_i$$

kde: *a* – koeficient možného nedodržení technologie,
b – koeficient stupně režimu ochrany porostů,
c – koeficient stupně přirozenosti lesních porostů,
KN – kvantifikace jednotlivých určených rizik.

Kvantifikace jednotlivého rizika závisí na stupni rizika (*SR*), naplnění rizika (*NR*) a účinku naplnění rizika (*UNR*), který zahrnuje časový aspekt – dlouhodobost rizika. Zaveden je i koeficient neprognózovatelného rizika (*KNR*). Kvantifikace jednotlivého rizika je pak kalkulována na základě vztahu:

$$KN_i = (SR \,.\, NR \,.\, UNR) + KNR$$

Hodnotíme-li využitelnost technologií na základě kvantifikace rizik ve třech základních stupních – přijatelné, problematické, nepřijatelné, můžeme konstatovat, že přijatelné technologie, tedy využití produkční funkce lesa při zachování cílů ochrany, je možné uplatnit i v části tzv. bezzásahových zón. Je však jisté, že v zásadě jedinou možností omezení rizik je za předpokladu volby optimální technologie její zcela precizní aplikace. Dále je jisté, že při využití produkční funkce lesů ve zvláště chráněných územích nelze odstranit tzv. oblast společenských rizik, která sice cíl ochrany neohrožuje, ale lokálně může sehrát významnou roli.

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