Are Forest Functions a Useful Tool for Multi-objective Forest Management Planning? Experiences from Slovenia

Tina Simončič, Andrej Bončina

Abstract

The concept of forest functions evolved in Central Europe as an important tool in the practice of multi-objective forest management. It is based on designating forest function areas that are relatively more important for the selected services. Recent practice has raised a number of concerns regarding the suitability and effectiveness of the concept of forest functions in satisfying increasing social demands on forests. This paper presents the main results of a survey of forest functions in Slovenia as seen by forestry experts (n=162). There was broad agreement among respondents that there are too many forest function types, and that at most two levels of importance should be applied. Principal component analysis identified four main purposes for designating forest function areas: harmonisation of forest uses, identification of conflict areas, and argumentation for land use planning; setting management priorities and strategies such as limitations for harvesting and skidding; providing a framework for financial subsidies for adjusted forest management; guiding forest road planning and construction.

Respondents identified designation of forest function areas in both public and private forests, and their high importance for land use planning as the major strengths of the concept. Major weaknesses were an insufficient monitoring and planning system, and complicated forest function mapping. It seems that forest functions have remained an important tool in the practice of multi-objective forest management. However, improved planning methods, increased public participation and greater integration of forest functions in forest policy are needed.

Keywords: multiple forest use, integration model, concept of forest functions, services, forestry experts, survey

1. Introduction

In Central Europe, the integration model of multi-objective forest management prevails. This management approach considers all forest functions at the same place and time, although their importance can differ (Borchers 2010). The pillar of the integration model is the »concept of forest functions«, which is based on the designation of areas with important forest functions (hereafter forest function areas) that are of relatively higher importance for the selected forest services (functions) than the surrounding forest area (Blum et al. 1996). The concept was developed in the 1950s by Dietrich (1953), who defined a forest function as a social demand imposed on forests. Most of the variants and definitions that followed relied on Dietrich's work (e.g. Rupf 1960, Hasel 1971). Multifunctional forest management was developed due to increasing demands for environmental services (e.g. Mantel 1990). It first came into use through the wake water paradigm, which is based on the assumption that management for sustainable timber production ensures ecological and social functions at the same time (Glück 1982). Later, »forest function mapping« was integrated into multifunctional forest management (Riegert and Bader 2010). The concept of forest functions was gradually affirmed in the practical forestry of Central European countries (especially in

Switzerland, Germany, Austria and Slovenia) in the 1980s and 1990s (Volk 1987, Anko 1995) and has remained an important tool in multi-objective forest management.

Three groups of forest functions are commonly defined by forestry legislation: production, ecological (or also protective) and social functions (e.g. Forst Act 1975, ZG 1993). The production function refers to the use of timber and other wood and non-wood products. Ecological functions include protection against natural hazards; the protection of soil, water and climate; and the conservation of natural habitats and biological diversity. Social functions are mainly connected to recreation and other cultural and educational values, and the protection of natural and cultural heritage. Detailed classifications of forest functions differ significantly among Central European countries (Simončič et al. 2013). For example, in Germany approx. 20 forest function types are classified, although the number may differ among federal states (e.g. Volk and Schirmer 2003). In Austria and Switzerland, the classification systems are simpler. In Austria, protective, protection, social and welfare functions are distinguished (Fürst and Schaeffer 2000), whereas in Switzerland, protective, protection, social and nature conservation functions are commonly defined (BUWAL 1996). Forest development plans (Ger. Waldentwicklungspläne) are the main tools for designating forest function areas and for prescribing management guidelines to promote the selected functions.

The concept of forest function areas has contributed greatly in emphasizing the public importance of forests (Bachmann 2005, Bürger-Arndt 2012) and mitigating conflicts between forest uses (Hanewinkel 2011). In addition, forest function areas have become influential in spatial planning as an important argument for environmental impact assessment in forest areas (e.g. Berger and Ray 2004, Schulzke and Stoll 2008). They have also led to better communication between forestry practitioners and stakeholders (Krott 1985). Nevertheless, a number of concerns have been raised regarding the suitability and effectiveness of the concept of forest functions in practicing multi-objective forest management. Applying fine scale mapping, overlapping and ranking of forest function areas has often failed to meet the diverse demands on forests, mainly due to poorly defined management measures associated with the forest function areas (Weiss et al. 2002), the lack of financial support for adjusted forest management (Buttoud 2002) or limited options for the participation of forest owners and public in the designation process (Ruppert-Winkel and Winkel 2009). In addition, the concept has often been criticized for being too general and prescriptive (e.g. Krott 1985). Another point of concern is that the discourse has not considered an effective reward system for social services provided by forest enterprises (Pistorius et al. 2012). However, there are significant differences among CE countries in how the concept has been applied (Simončič et al. 2013).

In Slovenia, forest functions have been used in forest management planning for nearly three decades. However, with the exception of recent research (e.g. Bončina and Matijašić 2010, Planinšek and Pirnat 2012, Simončič and Bončina 2012, Mavsar et al. 2013, Simončič et al. 2013, 2015), they have not been a popular topic of interest among scientists. Accumulated experience in the implementation of the concept during the last decades and new regulations regarding multi-objective forest management underscore the need to evaluate the effectiveness of forest functions as a tool in the practice of multi-objective forest management. We used a survey among forestry experts in Slovenia to explore:

- ⇒ their perceptions on the designation of forest function areas, including the importance of forest function areas in practicing multi-objective forest management;
- ⇒ whether these perceptions differ among different groups of forestry experts.

2. The concept of forest functions in Slovenia

In Slovenia, wood and non-wood forest functions gained equal importance with the enforcement of the Forestry Act in 1993 (ZG 1993). In the last three decades, the classification of forest function types has been developed (Anko 1995), and detailed criteria and procedures for designation of forest function areas have been elaborated (Pravilnik 1998, 2010). The forestry act classifies three main groups of forest functions (social, ecological and economic) and further defines 17 forest function types (Table 1).

Forest function areas are designated in the regional forest plans, which are the strategic plans made at the level of forest management regions (14 in Slovenia). Regional forest plans are aimed at defining objectives, priorities and controlling mechanisms for ensuring public interests and management of the forest. They are approved by the government. In addition, forest function areas are supplemented in the forest management unit plans, in which operational and frame planning is combined (Bončina 2001). Forest function areas are updated every 10 years in the frame-

work of regional forest plan revisions. This is a multi-step process consisting of:

⇒ collecting information about forest functions from various institutions (e.g. water protection zones, Natura 2000 sites, hiking trails, natural hazard potential);
⇒ checking and harmonizing information about forest functions with forest management unit plans;
⇒ GIS analyses and preparation of forest function maps;
⇒ setting management guidelines associated with the forest function areas;
⇒ harmonizing the maps and associated management prescriptions with other institutions, the public and forest owners.

Forest function mapping in Slovenia is partly similar to the methodology used in Germany and Austria. The forest function map is elaborated on a 1:25,000 scale. The minimum mapping area has the same threshold as for the designation of forest area, which is 0.25 ha. To avoid multiple overlapping that often occurs between 17 types of functions, a synthesis map of the four main categories of forest functions is produced in the regional forest plan, although the database enables the presentation of individual functions on any spatial level (Fig. 1). The importance of each function is ranked according to three levels:

⇒ first level – function determines management regime;
⇒ second level – function influences management regime;
⇒ third level – function has no significant influence on management regime.

Each forest area is designated with a function; if no function is explicitly important, wood production is automatically ranked as primary (first or second level of importance). Due to overlapping, the sum of forest function areas is greater than the surface of the forest area (Fig. 2).

In private forests, financial support is available if additional measures are needed when there are trade-offs between owners' objectives and public demands. The main benefits available for private owners for providing non-timber functions are the right to full or partial financial support of silvicultural and protective measures. The amount of subsidies partly depends on the importance of social and ecological forest functions. In the case of the first or second level of importance, the basic amount of subsidies available for management is increased by 20% and 10%, respectively.

Table 1 Distribution of forest function areas in Slovenia according to the first and the second level of importance (source: SFS 2012). Total forest area amounts to 1.2 million hectares

Function	Percentage of the whole forest area	
	First level, %	Second level, %
Protection	15.4	24.9
Hydrologic	5.1	44.6
Habitat protection	5.0	59.6
Climatic	2.9	3.5
Protective	2.2	0.4
Hygienic-health	2.3	6.0
Recreational	2.4	5.0
Touristic	2.5	2.4
Educational	0.6	0.4
Research	0.8	0.0
Protection of natural heritage	3.0	14.6
Protection of cultural heritage	0.4	13.3
Aesthetic	2.8	7.0
Defence	1.1	1.3
Timber production	59.6	24.4
Non-wood products	1.4	20.1
Game management	2.8	0.0

3. Methods

3.1 Survey methodology

A web based questionnaire (implemented with SurveyMonkey; www.surveymonkey.com) was conducted during February and June 2013 among different groups of forestry experts (Table 2). The questionnaire was first pilot tested through face-to-face interviews with the scientists of the study and further refined. Before data collection, it was additionally tested on six representatives (two local foresters, two scientists, and two planners). The survey lasted 25 minutes on average. Invitations to respond to the questionnaire were distributed by email. Each questionnaire was enclosed with a cover letter identifying the general purpose of the study and key contact person.

The questions were conducted based on our previous research (e.g. Simončič and Bončina 2012), a literature review, analyses of existing legal documents, personal discussions and interviews with forest plan-

ners and local foresters, and consultations with on-the-ground practitioners. For the purpose of the paper, only one part of the questionnaire is presented. The questionnaire contained structured questions. The socio demographic characteristics included information about the respondents' sex, age, education, work location and work position. The questions about types and ranking of forest functions were the multiple response type. Before the interviews, we prepared a list of 16 purposes that we hypothesized forestry experts might consider as the main reasons for designating forest function areas. The respondents were then asked to express the degree of importance of forest function areas to the pre listed purposes with a grading scale. The grading scale was a five point ordinal Likert type scale (Likert 1932):

⇒ (1) not at all important;
⇒ (2) rather unimportant;
⇒ (3) not important and not unimportant;
⇒ (4) rather important;
⇒ (5) very important.

The questions consisted of individual Likert items. For a general evaluation of the concept of forest functions, we prepared a list of 17 statements associated with the designation of forest function areas and subsequent management. Answers to each question were given as a reflection of choices from the strongest agreement (1) to the strongest disagreement (5). We used affirmative and negative statements to encourage respondents to carefully consider each statement and to decrease automatic responses. We then applied cross dating to get parallel statements and to be able to perform statistical tests.

3.2 Respondent profile

The survey population consisted of forestry experts from three institutions. A total of 162 responses were analyzed out of approximately 800 people, representing about 25% of the population. The respondents were then classified into three main groups according to their work positions. For the total sample, scientists represented 30% and practitioners (local foresters and planners) about 22% of the population. The average age of

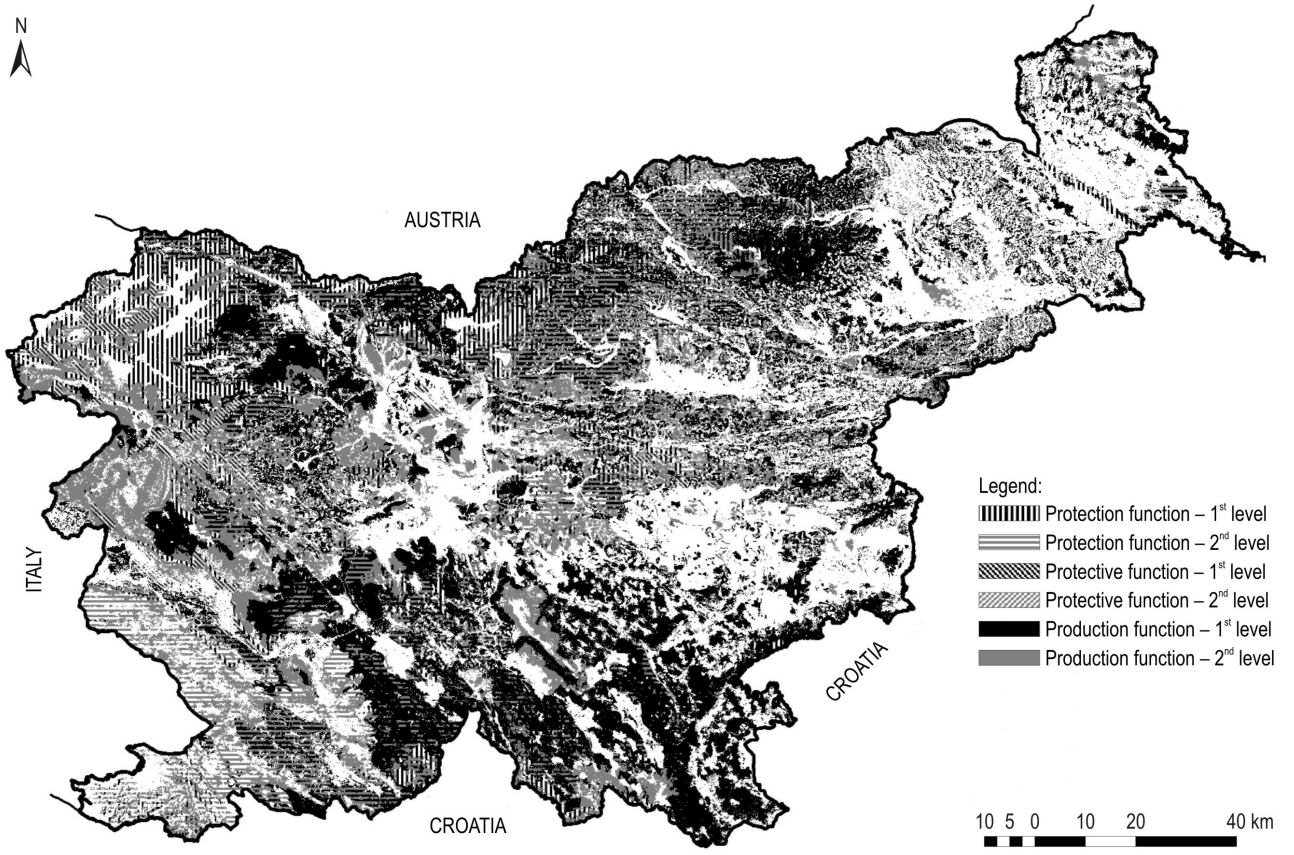

Fig. 1 Map of selected forest function areas at the national level with the first and second level of importance (source: SFS 2014). Protection refers to indirect protection; protective means direct protection of objects; production refers to the timber production

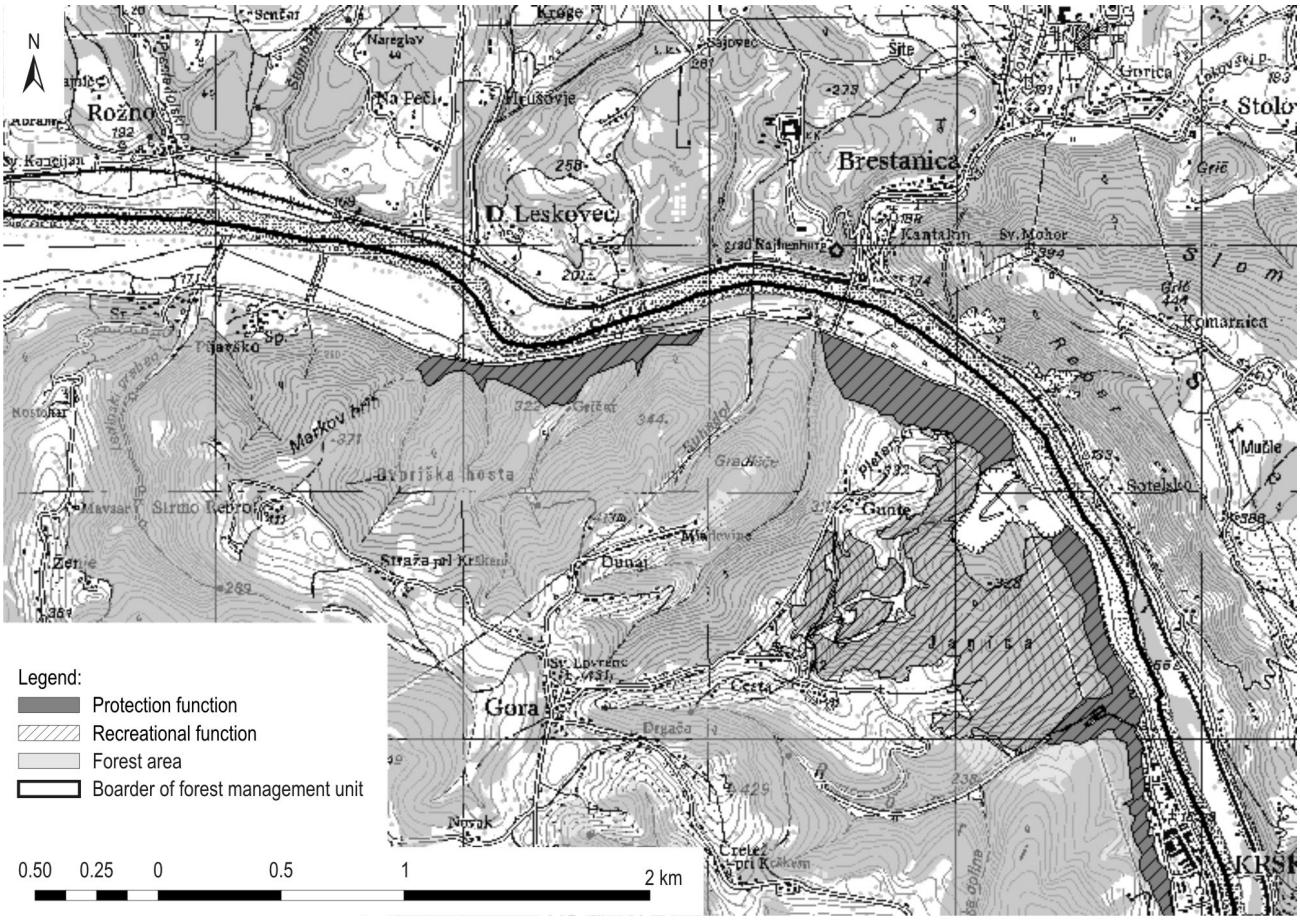

Fig. 2 Section from forest function map at the landscape spatial scale. Only protection and recreational functions of first level of importance are shown

Table 2 Respondents included in the survey

Group	Organization*	Working position	Number of responses, *n*
Local foresters	SFS	District forester	71
	SFS	Head of local unit	24
Planners	SFS	Forest planner at local or regional unit	29
	SFS	Other employee of regional unit	19
	SFS	Employee of central unit	4
Scientists	BF	Researcher	14
	SFI	Researcher	1

* SFS – Slovenia Forest Service; SFI – Slovenian Forestry Institute; BF – Biotechnical Faculty, Department of Forestry

the interviewees was 45 years. Men (88%) prevailed in the survey. The majority of interviewees had university education (43%), followed by higher professional school (37%), a master's or PhD degree (16%) and high school (4%). The respondents mainly work in the forest or forested landscape (74%), followed by agriculture (14%) and the suburban and urban landscape (12%).

3.3 Statistical data analysis

The results were analyzed using Excel and SPSS (IBM 2011). Mean, standard deviation and frequency distribution were used as the basic statistics in the data analysis. The differences between different groups of forestry experts were tested using the χ^2 test. Due to the sample size, the Likert grades were joined into the following categories:

⇒ strongly disagree and disagree;
⇒ neutral;
⇒ agree and strongly agree.

Table 3 Respondent opinions on the number of forest functions

The Forestry Act and planning regulations define 17 forest functions. What is your opinion on the number of forest functions?	Local foresters, %	Planners, %	Scientists, %	All, %
Number of forest functions is adequate	49.5	21.2	13.3	37.0
Number of forest functions is too high	44.2	78.8	86.7	59.3
Number of forest functions is too low	0.0	0.0	0.0	0.0
Undecided	6.3	0.0	0.0	3.7

The number of responses allowed us to only test differences between local foresters and planners, whereas differences with scientists were analyzed by comparing the frequency distribution of responses.

The factors influencing the perceived importance and general evaluation of the concept were analyzed by bivariate Spearman correlation coefficient (r) between the respondents' socio-demographic variables and their opinions, which is commonly used to analyze Likert scale data (Norman 2010). In our case, we compared independent categorical variables such as gender, age, working position, etc. with dependent variables consisting of ordinal data (Likert grades).

We applied principal component analysis (*PCA*; Hill and Lewicki 2007) in SPSS to identify the major categories of importance of forest function areas from the list of 16 statements. *PCA* is a type of exploratory factor analysis that explains the maximum amount of common variance in a correlation matrix using the smallest number of explanatory factors (Field 2000). We chose this approach because the correlation analysis found a degree of interdependence of the data, estimated by Pearson correlation coefficient, at 0.05 and 0.01 significance levels. The reliability of the *PCA* was evaluated using the Kaiser-Meyer-Olkin measure of sampling adequacy (*KMO*). *KMO* greater than 0.7 is considered as an acceptable reliability coefficient. Also, we applied Bartlett's test of sphericity to check the suitability of our data for data reduction. The significant value for this analysis (P=0.00) led us to reject the null hypothesis and conclude that there are correlations in the data set that are appropriate for factor analysis. Based on the Kaiser criterion, only components with an eigenvalue greater than one were considered. Thus, the first four principal components (PCs) were extracted (controlling for 68.7% of the variance) and subsequently rotated with varimax rotation to increase their interpretability.

4. Results

4.1 Number and types of forest functions

The majority (59.3%) of the survey respondents indicated that the number of forest functions is too high (Table 3). We found a statistically significant difference between different groups of forestry experts

Table 4 Respondent opinions on the types of forest functions

Which (if any) forest functions would you no longer designate?	Local foresters, %	Planners, %	Scientists, %	All, %
Defence	28.4	42.3	46.7	34.6
Hygienic-health	23.2	38.5	13.3	27.2
Touristic	12.6	38.5	13.3	21.0
Climatic	12.6	30.8	20.0	19.1
Aesthetic	8.4	32.7	26.7	17.9
Educational	8.4	26.9	0.0	13.6
Protective	10.5	11.5	0.0	9.9
Non-wood products	8.4	7.7	6.7	8.0
Research	5.3	9.6	0.0	6.2
Protection of cultural heritage	4.2	11.5	0.0	6.2
Protection of natural heritage	2.1	11.5	0.0	4.9
Recreational	1.1	3.8	0.0	1.9
Hydrologic	0.0	3.8	0.0	1.2
Wood production	1.1	1.9	0.0	1.2
Protection	0.0	0.0	6.7	0.6
Game management	0.0	1.9	0.0	0.6
Habitat protection	0.0	0.0	0.0	0.0

(P<0.001). The frequency distribution of the responses showed that the number of forest functions is adequate for about half of local foresters, whereas there is broad agreement among planners and scientists that there are too many types of forest functions.

Most respondents would no longer designate areas with the defence, hygienic and health, touristic, climate and aesthetic functions (Table 4). There is a statistically significant difference between different groups of forestry experts regarding the touristic (P=0.001), educational (P=0.002) and aesthetic functions (P=0.001). The frequency distribution of responses shows that a higher share of planners compared to the other two groups would no longer designate touristic, educational and aesthetic functions, the latter also being the case for scientists.

We asked the respondents if they would combine any forest functions. The most common combinations of functions were the following: recreational and touristic (58.6%), protection and protective (38.3%), educational and research (38.3%), protection of cultural and natural heritage (32.7%), and climatic and hygienic–health (27.8%). We found statistically significant differences among forestry experts in combining climatic (P=0.000), recreational (P=0.005) and educational functions (P=0.007). Most (86.3%) local foresters would not combine the climatic function with any of the other functions, whereas about half of scientists and planners would combine the climatic function with other functions. About half (51.6%) of local foresters would not combine the recreational function with other functions, whereas the majority of planners (75.0%) and scientists (60.0%) would combine the recreational function with other functions.

4.2. Ranking of importance of forest functions

The majority (58.7%) of respondents would change the current ranking system and most would apply the first and second level of importance (Table 5). We found statistically significant differences among different groups of forestry experts (P=0.001). The frequency distribution of the responses points to the largest differences among local foresters and the other two groups, with local foresters being less critical of the current ranking system.

4.3 Perceived importance of forest function areas

The lowest importance of forest function areas was given to the following purposes: financial subsidies for management restrictions, financing additional works, planning silviculture and protection works and selection of trees to be cut (Table 6). The highest importance was given to arguments against deforestation of forestland, basis for environmental impact assessment and influence on forest road construction. A higher share of planners (69.2%) compared to local foresters (51.6%) pointed to the importance of forest function areas for environmental impact assessment (P=0.015), whereas a higher share of local foresters (60.0% and 74.7%, respectively) compared to planners (34.6% and 53.8%, respectively) pointed to the importance of forest road planning (P=0.009) and the implementation of harvesting and skidding (P=0.034).

PCA analysis revealed four major categories of importance among the 16 designation purposes, which explained 68.7% of the variability in decision making (Table 7). The highest importance of designating forest function areas (*PC* 1), accounting for 23.2% of the total variability, was for planning forestland use and broader land use planning. *PC* 1 had the highest loadings of factors (six factors with factor loadings higher than 0.70). The second category (*PC* 2) represented the importance of forest function areas for planning and implementing management measures and explained 21.5% of the variance. We identified a third *PC* as the importance of financial subsidies. It additionally explained 14.9% of the variability. *PC* 4, which describes the importance for forest road construction, additionally explained 9.1%.

Respondent's age and forest management region had no significant correlations with perceived importance of forest function areas, whereas working posi-

Table 5 Respondent opinions on ranking the importance of forest functions

Which levels of importance would you use?	Local foresters, %	Planners, %	Scientists, %	All, %
Current system of three levels of importance	53.7	19.2	20.0	39.5
First and second level of importance	27.4	46.2	33.3	34.0
First level of importance	7.4	23.1	20.0	13.6
First level of importance or second where the areas overlap	9.5	9.6	26.7	11.1
Undecided	2.1	1.9	0.0	1.9

Table 6 Respondent perceptions of the importance of forest function areas (the frequency distribution of the responses in %)

Statement	Likert scale*					
	1	2	3	4	5	*Avg.±st. dev.*
Assessment of deforestation of forestland	0.6	1.9	12.3	45.1	40.1	4.22±0.78
Environmental impact assessment	0.6	3.7	15.4	39.5	40.7	4.16±0.86
Forest road construction	/	3.7	19.1	39.5	37.7	4.11±0.84
Planning road construction	0.6	2.5	22.2	43.2	31.5	4.02±0.83
Participation in elaboration of land use plans	1.2	6.8	24.7	47.5	19.8	3.78±0.88
Identification of conflict areas	2.5	5.6	25.9	44.4	21.6	3.77±0.93
Harvesting and skidding implementation	0.6	11.1	22.2	48.1	17.9	3.72±0.91
Harmonization of multiple forestland uses	1.2	6.2	34.6	40.7	17.3	3.67±0.88
Participation with forestland users	2.5	10.5	34.0	40.1	13.0	3.51±0.93
Maximum allowable cut	1.9	9.9	39.5	34.6	14.2	3.49±0.92
Subsidies for silviculture works	2.5	15.4	32.1	34.6	15.4	3.45±1.01
Planning additional works	4.9	9.9	38.9	34.6	11.7	3.38±0.99
Selection of trees to be cut	/	19.8	38.3	32.7	9.3	3.31±0.89
Planning silviculture and protection works	1.9	18.5	36.4	36.4	6.8	3.28±0.91
Financing additional works	5.6	19.8	32.1	30.9	11.7	3.23±1.07
Financial subsidies for management restrictions	10.5	21.0	27.8	25.9	14.8	3.14±1.21

* 1 – unimportant; 2 – rather unimportant; 3 – not important and not unimportant; 4 – rather important; 5 – very important

tion had the strongest. Local foresters and local planners acknowledge forest function areas as more important for the selection of trees to be cut (r=–0.21, P<0.01), maximum allowable cut (r=–0.29, P<0.01) and harvesting and skidding implementation (r=–0.23, P<0.01), whereas higher officials and scientists find forest function areas more important for identification of conflict areas (r=0.17, P<0.05), harmonization of multiple forestland uses (r=0.22, P<0.01), environmental impact assessment (r=0.20, P<0.05) and assessment of deforestation of forestland (r=0.18, P<0.05). Men find forest function areas more important for the selection of trees to be cut (r=–0.17, P<0.05) and maximum allowable cut (r=–0.19, P<0.05), whereas women perceive environmental impact assessment as more important (r=0.18, P<0.05), although this may be related to the higher share of women among forest planners and scientists compared to the share of women among local foresters.

4.4 General evaluation of the concept of forest functions

Respondent opinions point to the following greatest weaknesses of the concept of forest functions (p[rating<3]>0.50): the lack of financial instruments, complicated forest function mapping, poor monitoring of the effectiveness of management measures and insufficient participation of stakeholders, especially forest owners in the designation process (Table 8). The main advantages of the concept (p [rating>3]>0.50) were designation of forest function areas in public and private forests, ranking of the importance of functions and usefulness of forest function maps for spatial planning. Five statements showed statistically significant differences among forestry experts. The frequency distribution of responses indicated that planners are more critical of forest function maps (p [rating>3]=0.35) compared to local foresters (p [rating>3]=0.13) and of the system of financial instruments (planners p [rating>3]=0.885; local foresters p [rating>3]=0.632). Significant differences were also found regarding ownership focus. For example, 1.9% of planners support the designation of forest functions only in agreement with the owners, whereas the proportion of local foresters is higher in this regard (16.8%).

The strongest correlations were found between the general evaluation of the concept and respondent

Table 7 Factor loadings in the *PCA* analysis of respondent perceptions of the importance of forest function areas (*N*=162, *KMO*=0.841)

Importance	Categories of importance*			
	*PC*1	*PC*2	*PC*3	*PC*4
Harmonization of multiple forestland uses	0.82	–	–	–
Environmental impact assessment	0.76	–	–	0.43
Participation in elaboration of land use plans	0.76	–	–	–
Identification of conflict areas	0.75	–	–	–
Participation with forestland users	0.73	0.31	–	–
Assessment of deforestation of forestland	0.71	–	–	0.47
Selection of trees to be cut	–	0.85	–	–
Maximum allowable cut	–	0.80	–	–
Planning silviculture and protection works	–	0.78	–	–
Harvesting and skidding implementation	–	0.72	–	–
Financing additional works	–	–	0.85	–
Financial subsidies for management restrictions	–	–	0.80	–
Subsidies for silviculture works	–	–	0.74	0.32
Planning additional works	0.31	0.35	0.55	–
Forest road construction	–	0.54	–	0.62
Planning road construction	–	0.58	–	0.62

Extraction Method: *PCA* with varimax rotation and Kaiser normalization.
Bolded loading indicates a value greater than 0.50, loadings below 0.25 are not shown.
*Main principal components (*PC*):
*PC*1 – planning forest land use and broader land use planning;
*PC*2 – planning and implementing management measures;
*PC*3 – financial subsidies;
*PC*4 – road construction.

working position. Negative correlations point to the conclusion that local foresters and forest planners at local and regional units are more critical of unclear forest function maps (r=–0.18, P<0.01), designation of forest functions areas without owner agreement (r=–0.24, P<0.01) or in private forests in general (r=–0.26, P<0.01), whereas higher officials and scientists are more critical of the system of financial instruments (r=0.16, P<0.05) and monitoring of management measures (r=0.33, P<0.01). Men tend to be more critical of financial instruments (r=–0.20, P<0.01) and the monitoring system (r=–0.17, P<0.01) than women, whereas women are more critical of forest function maps (r=–0.18, P<0.01) and the complicated description of forest functions in management plans (r=–0.17, P<0.01).

5. Discussion

Our study addressed several topics regarding the concept of forest functions in Slovenia. The first was the classification system (i.e. number, types and ranking of forest functions). There was broad agreement among respondents (although less for local foresters) that the current number of forest functions is too high. The respondents would either combine many of the existing forest functions, or would not designate some of them. One of the reasons for such a response could be that some forest function types are designated for similar reasons (e.g. recreational and touristic functions) or with regard to rather vague designation criteria (e.g. hygienic–health function). Other CE countries, such as federal states in Germany (e.g. Gross 2007) or in the eastern part of Central Europe, even have more detailed classification of forest function types (Simončič et al. 2013), whereas Austria and Switzerland classify only four to five main functions (BUWAL 1996, Fürst and Schaeffer 2000). The latter approach seems to be more appropriate for forest management given that differentiating and mapping a high number of functions is not practical for collaboration with stakeholders or for implementing forest management (Bončina et al. 2014). In addition, some of the existing forest functions (e.g. climatic function) are not dependent on forest management and can be provided without spatial designations.

Most of the respondents in our survey would apply only the first and second level of importance. The current ranking system of the importance of forest functions used in Slovenia is similar to the Austrian system, which applies four ranks (WEP 2006). In Germany, only recreational (two levels according to the intensity of recreation) and hydrological functions (two levels according to water regulations) are commonly ranked (Waldfunktionen Kartierung 2004). In Switzerland, most cantons apply one level – the priority function (Ger. *Vorrangfunktion*, Kantonale Waldplanung 2007), and some also a second level – the secondary function (Ger. *Nebenfunktion*). Forest functions are ranked between each other, which differs from the Slovenian approach, where multiple functions can have the first level of importance in the same forest area. The approach used in Switzerland clearly defines priorities between functions, which is important for prescribing management regimes, since management regimes associated with each function might not be completely compatible.

Respondents identified several reasons why forest function areas are an important tool in the practice of multi-objective forest management, from identifying conflict areas and setting management priorities to collaboration with stakeholders and argumentation in spatial planning. The diverse importance of forest functions should show in the designation process; the designation criteria should be simple enough to articulate various demands on forests, but also clear and transparent, especially if state funds are available for adjustments of forest management to support public services. In such cases, the participation of forest owners and other relevant stakeholders becomes even more important. Good examples are protection forests in Switzerland that are strongly supported by cantonal or even national budgets (Schmidt 2010).

Surprisingly, respondents placed the highest importance on the influence of forest function areas on spatial planning, which is probably connected to the dramatic land use changes during the last decade triggered by European Union subsidies for agricultural lands. Forest planners decide if small scale conversions from forest to agricultural lands are admissible, and in such cases forest function areas become important arguments against deforestation (Bončina and Matijašić 2010). The respondents assigned relatively low importance to forest function areas for implementing forest management, despite the mandate from the state that forest function areas of first level of importance should determine forest management regimes (ZG 1993). This could be connected to the lack of state funds to support adjusted management in both public and private forests, which is a weakness identified by foresters in this and other surveys (e.g. Bončina et al. 2014). In addition, many respondents criticized complicated forest function maps containing a large number of overlapping forest functions, which could be another reason for the relatively small management importance of forest function areas. Furthermore, large forest areas are ranked with the second level of importance, which has very little or even no influence on forest management regimes (Simončič and Bončina 2012). Experiences show that clear prioritization of forest function areas, which are not determined for the entire forest area but focused on areas with specific importance for multi-objective forest management, provides a much better basis for setting management measures, and at the same time significantly contributes to mitigating conflicts between forest uses (e.g. Hanewinkel 2011).

Recently, the evolving concept of »ecosystem services« (EUSTAFOR and Patterson 2011) has been seen as a way forward to overcome some of the shortcomings of the concept of forest functions (Bürger-Arndt 2013), as it improves communication with the public, evaluates non-monetary functions (services) and consequently establishes a reward system for those providing public services (Weiss et al. 2011). However, important conceptual differences between the two concepts exist (e.g. Pistorius et al. 2012) and should be considered when adopting the language of ecosystem services in the concept of forest functions.

We partly confirmed that forestry experts have different perceptions of the concept of forest functions. Planners and scientists were more critical of classification and mapping compared to local foresters. This seems to be the result of the great deal of time planners need to spend in elaborating forest function maps. On the other hand, local foresters were more critical of the designation of forest function areas without the participation of private owners. Provision of public forest services may be more difficult to apply in private forests due to the divergent objectives of forest owners (Ficko and Bončina 2013) or the need to compensate for trade-offs between private and public demands (Cubbage et al. 2007), and local foresters directly involved with private owners may be much more aware of these issues.

6. Conclusion

Forest functions remain an important tool in the practice of multi-objective forest management in Slovenia; they are the basis for presenting the public importance of forests, they play a large role in preventing deforestation of forestland, and are to some degree important for spatial differentiation of management measures and for financial support for providing public services. Improving the classification scheme and mapping of forest functions is a relevant task; however, changing the focus from »mapping« to management activities, which are necessary for providing the desired services, might be even more important. Nevertheless, the importance of forest function areas for multi-objective forest management will strongly depend on their overall integration into forest and environmental policy, especially the available financial support of the state.

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Authors' address:

Tina Simončič*
e-mail: tina.simoncic@bf.uni-lj.si
Prof. Andrej Bončina, PhD.
e-mail: andrej.boncina@bf.uni-lj.si
University of Ljubljana
Biotechnical Faculty
Department of Forestry and Renewable Forest Resources
Večna pot 83
1000 Ljubljana
SLOVENIA

* Corresponding author

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Appendix

Table 8 General evaluation of the current concept of forest functions

Statement	Likert scale*						
	1	2	3	4	5	*Avg.* ±*st. dev.*	*P*-value
The system of financial instruments for adjusted forest management on forest function areas is sufficient	29.6	42.0	24.7	3.7	0.0	2.02±0.83	0.003
Forest function map is too complicated due to a large number of forest functions**	27.8	37.7	25.9	8.6	0.0	2.15±0.93	0.000
Forest function map is clear due to overlapping of forest function areas	21.6	40.7	27.8	8.6	1.2	2.27±0.94	–
Monitoring of management measures supporting forest functions is sufficient	13.6	45.7	30.2	9.3	1.2	2.39±0.88	–
Participation of forest owners in the designation of forest function areas is not sufficient**	8.6	42.6	32.7	14.8	1.2	2.57±0.89	–
Stakeholders' participation in the designation of forest function areas is sufficient	4.9	39.5	43.2	12.3	0.0	2.63±0.76	–
Forest function areas are uncritically adopted from other institutions (e.g. Natura 2000 sites)**	11.7	25.3	45.7	14.2	3.1	2.72±0.96	–
Descriptions of forest functions in forest plans are too extensive**	8.0	27.2	42.0	22.2	0.6	2.80±0.90	–
Descriptions of forest functions in forest plans are too general**	11.1	21.0	35.8	30.2	1.9	2.91±1.01	–
Forest function map is not useful for planning management measures**	6.8	13.6	47.5	29.0	3.1	2.92±0.91	–
Management measures on forest function areas are clearly defined in management plans	3.1	22.2	51.2	21.0	2.5	2.98±0.81	0.007
Information on forest function areas is not readily accessible to the public**	2.5	17.9	40.1	29.0	10.5	3.27±0.96	–
Forestry experts have enough/sufficient competences in designating forest function areas	3.1	13.6	37.7	35.2	10.5	3.36±0.95	–
Forest function map is useful for collaboration in spatial planning	1.2	8.6	38.3	45.7	6.2	3.47±0.79	–
The ranking levels of importance of forest functions are important for setting management priorities	1.2	8.6	33.3	48.8	8.0	3.54±0.81	–
Forest function areas should be designated only in agreement with forest owners**	1.2	9.3	24.7	37.7	27.2	3.80±0.98	0.018
Forest function areas should not be designated in private forests**	0.6	2.5	10.5	42.6	43.8	4.27±0.79	0.001

* 1 – complete dissatisfaction with the system; 5 – complete satisfaction with the system

**Reverse coding applied