

Secondary School Students' Environmental Concerns and Attitudes toward Forest Ecosystem Services: Implications for Biodiversity Education

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ABSTRACT

Alarming declines in biodiversity have encouraged scientists to begin promoting the idea of the services ecosystems offer to humans in order to gain support for conservation. The concept of ecosystem services is designed to communicate societal dependence on various natural ecosystems. Schools play an important role in educating students to be active and responsible towards the environment. A questionnaire testing for the influence of different types of environmental concern on attitudes to forest ecosystem services was completed by 410 Slovenian secondary school students in north-western Slovenia. The students' attitudes to forest ecosystem services were investigated via 15 statements about provisioning, regulating, supporting and cultural services. The student's environmental concern was investigated using a questionnaire of 12 items. Results from the survey provide evidence that students' concerns for the consequences of environmental damage formed three correlated factors centred around the self and family, all people and the biosphere. Students' most highly valued environmental concern was for the biosphere, followed by concern for self and family, and concern for all the people. Female students were notably more concerned for all people and for the biosphere. However, all students, regardless of the type of environmental concern, prioritise the different benefits obtained from regulating and supporting ecosystem services. The importance placed on different provisioning and cultural services varies among students with different types of environmental concerns. The students' frequency of direct experiences being in the forest has a significant positive impact on the values they assigned to cultural services in particular. Education about ecosystem services could be an effective means of communicating the significance of various ecosystems and our dependence on ecological life support systems. By using ecosystem services frameworks students can learn about and value ecosystem structure and functions, as well as better evaluate human activities that are associated with them. Using ecosystem services frameworks and elaborated types of environmental concerns can help educators emphasize the attitudes/needs/rights of an individual and of a society to discuss these socio-scientific issues in a cooperative learning environment. Biodiversity education should not overlook cultural ecosystem services and address them in terms of changing human values and sustainability.

KEYWORDS

ecosystem services, environmental concern, secondary school students, forest, biodiversity

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Introduction

Natural capital assets such as land, water, and biota produce a range of ecosystem services which, when combined with others, contribute to human well-being (Costanza et al., 1997; MEA, 2005). It was alarming environmental changes that encouraged scientists to begin promoting the idea of the services biodiversity offered to humans. Ecosystem services were thus defined as the full range of benefits that humans obtain directly or indirectly from ecosystem processes (Costanza et al., 1997; Daily, 1997). The Millennium Ecosystem Assessment (MEA, 2005) grouped services into *provisioning*, such as the production of food and fuel; *regulating*, such as the control of climate and disease; *supporting*, such as nutrient cycles and crop pollination; and *cultural*, such as spiritual and recreational benefits. One of the key results of the Millennium Ecosystem Assessment was the finding that globally 15 out of the 24 ecosystem services investigated were in a state of decline (MEA, 2005).

The value of ecosystem services has been measured in economic terms to increase investment in environmental management (Daily et al., 2009) and support for biodiversity conservation (Goldman et al., 2009). The annual average value of all the services provided by global ecosystems to human beings was estimated at US \$33 trillion by Costanza et al. (1997). Foremost, the concept of ecosystem services is a key way to communicate societal dependence on natural ecosystems (Daily, 1997; De Groot et al., 2002).

Knowing local people's attitudes, taking into account their needs and respecting their opinions should become a priority for the success of conservation-related activities and the sustainable use of natural resources (Macura et al., 2011). Environmental attitudes are defined as a psychological tendency expressed by evaluating the natural environment with some degree of favour or disfavour, and are a crucial construct in the field of environmental psychology (Hawcroft & Milfont, 2010). Despite the immense natural capital and ecosystem services that forests provide, few studies comprehensively address human attitudes toward forest ecosystem services (e.g. Bartczak & Metelska-Szaniawska, 2015; Gao et al., 2013; Lindemann-Matthies et al., 2014; Torkar et al., 2014). For example, Lindemann-Matthies et al. (2014) investigated the attitudes of Chinese and Swiss people toward forest biodiversity and ecosystem services. They discovered that all participants highly valued forest ecosystem services, especially the regulating and supporting services. Similarly, Slovene secondary school students acknowledged the major benefits of ecosystem services provided by forests. They placed the highest importance on supporting services, especially on the value of forests as habitats for animal and plant species. Also, they emphasized the importance of forests for clean air production. Furthermore, Gao et al. (2013) found that ecosystem services were important to local residents in Southeast China and were the motivation to protect culturally important forests.

A growing number of people around the world are concerned about environmental problems, but they express different types of environmental concerns (Schultz, 2001, 2002). So a more interesting question is not whether people are environmentally concerned, but why they are concerned. Schultz (2001) explains that different types of environmental concern result from the degree to which an individual perceives an interconnection with their self and nature. By examining the different types of environmental attitudes we attempt to identify the values associated with different concerns (Schultz, 2002). Gender has been one of the most examined factors predicting concern about the environment. This influence appears vague and inconsistent. For example, Schultz (2001) and Torkar et al. (2010) stated that women are more concerned than men. On the contrary, Arcury (1990) indicated that men are more environmentally concerned than women. In contrast, Hayes (2001) and Van Liere and Riley (1980) argued that gender does not influence environmental concern.

A new and important contribution to the disquisition on ecological services and environmental concern is captured in the quote: "there can be no public health without animal health and ecosystem health," by Rock and Degeling (2015: 61). These authors have contributed to the research on the One Health initiative, which denotes an inter-sectoral approach to intervention premised on complex interdependence between humans, non-human

species and ecosystems, and is shifting towards concern with shared causes of the disease burden across non-human and human populations (Rock et al., 2009; Zinsstag et al., 2011). Rock and Degeling (2015) highlighted the inevitable tension between concern for the health of an individual, population, species and/or biosphere. They introduced the term "more-than-human solidarity" which implies people respecting (valuing) commitments to one another as well as to places, plants and non-human animals, because people appear not to be concerned for fellow humans in isolation from non-human animals nor from places, nor are people necessarily more concerned about fellow humans than about non-human species, individual animals, particular places or multi-species collectives.

The survey used for this study was designed to investigate secondary school students' environmental concerns and attitudes toward forest ecosystem services. The aim was to confirm a set of items that would assess each of the three wider issues in terms of valuing objects related to environmental concern as proposed by Schultz (2001). The research questions that guided this study are as follows:

1. How do students' environmental concerns correlate with their attitudes toward provisioning, regulating, cultural and supporting forest ecosystem services?
2. Does gender affect their environmental concerns and attitudes toward forest ecosystem services?
3. Does the frequency of direct experiences in forests affect their environmental concerns and attitudes toward forest ecosystem services?

Slovenia is the third most forested country in Europe with almost 63% of the land covered by forest (State of Europe's Forests, 2011). Consequently, forests are an essential feature and a constituent part of Slovenia's environment, holding high protective and social significance (Resolution on National Forest Programme, 2008). Schools have an important role in educating students for being active and responsible towards the environment. The white paper on education in the Republic of Slovenia states that schools should develop students' knowledge, attitudes and personal commitment towards the environment (Krek (ed.), 2011). Slovenia has introduced obligatory curriculum for environmental education as education for sustainable development which must be autonomously introduced into each primary and secondary school curricula. However there are leaks to do it in appropriate way (Šorgo and Kamenšek, 2012). Since Slovenia is one of the most forested countries in Europe, it is understandable that forests are the most extensively discussed natural ecosystems in the primary and secondary school curriculum. Primary school in Slovenia is divided into three three-year cycles (students aged 5 to 14). This is followed by a three- or four-year long upper secondary school programme (students aged 15 to 18). Learning objectives for environmental education and forest ecosystems are mainly achieved in the school subjects Science and Biology in the second and third three-year cycle of primary school and in secondary schools.

Method

Sample

Due to the great diversity of forest ecosystems in Slovenia, all the students were selected from NW Slovenia. The study sample comprised 410 first and second year students of general upper secondary school (in Slovenian: gimnazija). They were questioned via a self-administered questionnaire. More than 90% of students from the study area attend secondary schools in the selected towns (SORS, 2013). The sample consisted of 134 (32.7%) males and 276 (67.3%) females. Their average age was 15.64 years ($SD = 0.59$, $Min = 15$, $Max = 18$).

Design and Procedure

The administrations of randomly selected schools were contacted by phone to confirm or refuse their participation in the survey. Schools were later visited by a researcher who provided printed copies of the questionnaire and instructions for teachers. The questionnaire format is a widely used and useful instrument for collecting survey information (Cohen et al., 2011). Teachers conducted questioning in the classrooms at the beginning of science or biology lessons. Students' attitudes toward forest ecosystem services were investigated with the help of 15 statements about provisioning, regulating, cultural and supporting services, as defined by the Millennium Ecosystem Assessment (MEA, 2005). The attitudes toward forest ecosystem services were assessed on a Likert scale of 1 to 5 (1 – unimportant, 2 – somewhat unimportant, 3 – neither unimportant nor important, 4 – somewhat important and 5 – important). Environmental concerns were investigated using a questionnaire with 12 items and statistical method of analysis introduced by Schultz (2001). Minor adaptation of the items was necessary due to the specific group questioned – secondary school students, and the purpose of the study – forest ecosystems. Items "marine life" and "birds" were excluded and replaced by "all organisms on the planet". A Likert scale from 1 (not important) to 7 (supreme importance) was used. Environmental concern items were subjected to factor analysis (with direct oblimin rotation) (Table 1). Inspection of the correlation matrix revealed the presence of many coefficients of .3 and above. The Kaiser-Meyer-Olkin value was .87, exceeding the recommended value of .6 (Kaiser, 1970, 1974), and Bartlett's Test of Sphericity (Bartlett, 1954) reached statistical significance, supporting the factorability of the correlation matrix. Three factors with eigenvalues greater than 1.0 were derived. These three factors explained 68.2% of the total variance. The scree test proposed by Cattell (1966) and parallel analysis (Hayton et al., 2004) were used, and it was decided to retain three components for further investigation. Students were also asked some demographic questions and how frequently and why they visit forests. The questionnaire was provided to the students in the Slovene language. At all data collection steps full anonymity was guaranteed to the participants. Such studies by Slovene regulations do not need approval of an ethical committee or similar body.

Data Analyses

Data entry and analysis were conducted using the Statistical Package for the Social Sciences (SPSS). Basic descriptive statistics of numerical variables (mean, standard deviation, frequency) was employed. Environmental concern items were subjected to factor analysis (with direct oblimin rotation). The nonparametric Mann–Whitney (U) test was used to test for significant gender differences in environmental concern and Kruskal-Wallis test was used to test for significant differences in the three types of environmental concern. Spearman's product moment correlation (r_s) coefficient was used for exploring the relationship between attitudes toward forest ecosystem services and types of environmental concern.

Table 1. Factor analysis for students' environmental concerns.

Environmental concern for	Component		
	Concern for self and family	Concern for the biosphere	Concern for all the people
my future.	.840		
my health.	.853		
family (parents, brother, sister...).	.789		
me.	.761		
future of my children	.741		
animal species.		-.938	
plant species.		-.929	
all organisms on the planet.		-.887	
people in my community.			.780
people of all nationalities.			.727
fellow citizens.			.721
future generations.			.602

Results

Students' attitudes of environmental concern were assessed using twelve items for which mean scores and standard deviations (error bar) were calculated (Figure 1). Students' concern for their health, family and the future of their children were the most important, followed by concern for all living beings and animals. They rated people of all nationalities as the least important concern.

Scores for the three environmental concerns were generated by averaging the items. Alpha reliability for the three scales showed from acceptable to excellent internal consistency: concern for self and family (0.85), concern for all the people (0.72) and concern for the biosphere (0.92). Students' most highly valued environmental concern was for the biosphere ($M=5.51$, $SD=1.37$), followed by concern for self and family ($M=5.39$, $SD=1.18$), and concern for all the people ($M=4.59$, $SD=1.89$). The Shapiro-Wilk statistic was used to assess the normality of the distribution of environmental concern scores. Significant values ($p < .001$) for each of the groups suggest violation of the assumption of normality. There was a statistically significant difference between the scores for three groups of environmental concerns ($\chi^2 = 118.639$, $p < .001$). Further, effect size value ($\eta^2 = .29$) suggested a small practical significance (Cohen, 1988). The Mann-Whitney U-test was used to test for differences between concern for the biosphere and concern for self and family ($Z = -2.442$, $p < .015$), between concern for the biosphere and concern for all the people ($Z = -9.778$, $p < .001$), and between concern for self and family and concern for all the people ($Z = -8.808$, $p < .001$). Effect sizes are strong for differences between environmental concern for self and family and for all the people ($r = .44$) and between environmental concern for the biosphere and for all the people ($r = .48$). Further, effect size value for differences between environmental concern for self and family and for the biosphere is small ($r = .12$).

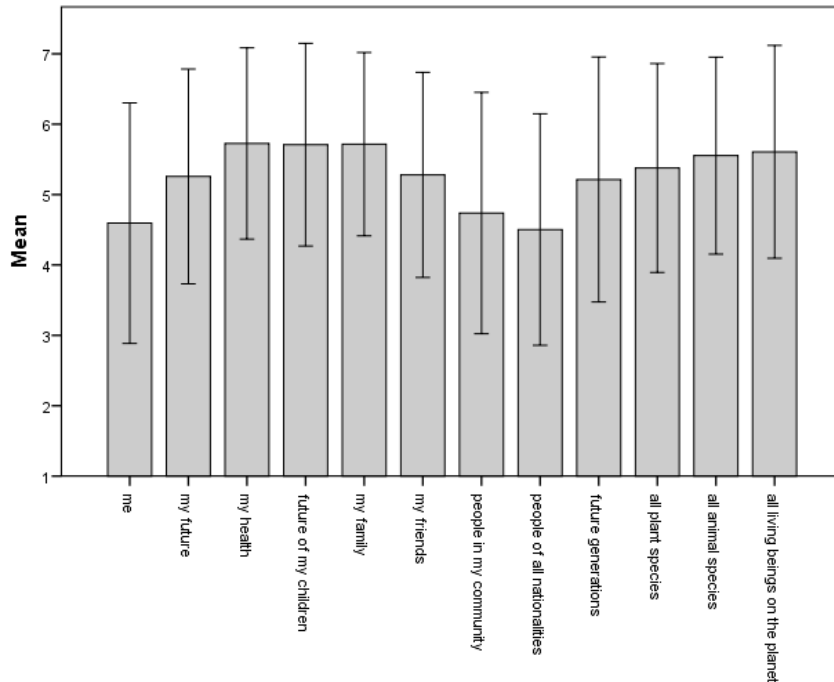


Figure 1. Mean score and standard deviation (error bar) for environmental concern items.

Next, differences between male and female students in environmental concerns were investigated. The Mann-Whitney U-test was used to test for differences in environmental concern scores by gender. The results of the test showed that the ranks for concern for all the people ($Z = -4.806$, $p < .001$) and concern for the biosphere ($Z = -2.024$, $p = .043$) differ significantly between male and female students; female students being more concerned. There is no statistically significant difference in the concern for self and family ($Z = -1.557$, $p = .120$) between males and females. Further, Cohen's effect size value for gender differences in environmental concern for all people ($r = .24$) suggested a moderate practical significance, and small significance for concern for the biosphere ($r = .10$) and concern for self and family ($r = .08$) (Cohen, 1988).

Not all forest ecosystem services have the same importance to secondary school students (Figure 2) ($F = 45.88$, $p < 0.001$). However, effect sizes in these differences were small ($d = .21$). Students placed the highest importance on supporting services ($M = 4.69$, $SD = .48$), especially on the value of forests as habitats for animal (D1) ($M = 4.85$, $SD = .42$) and plant species (D2) ($M = 4.81$, $SD = .47$). They also placed high importance on regulating services ($M = 4.57$, $SD = .73$). The importance of forests for the production of clean air (B5) was especially emphasized ($M = 4.85$, $SD = .38$). Surprisingly, they placed a lower importance on provisioning services ($M = 4.23$, $SD = .99$) than to supporting and regulating services. Importance of the forest for food production (A2) was rated significantly lower for students compared to the role forests play in wood (A1) and fuel production (A2). Students placed the least importance on cultural services ($M = 4.05$, $SD = .84$), where the lowest score was given to the aesthetic value (C4) ($M = 3.78$, $SD = .95$), ranked significantly lower than the other three cultural services provided by forests. Correlation coefficients were calculated between scores for ecosystem services and environmental concerns. Results are presented in Table 3. In general, regulating and supporting ecosystem services correlate most significantly with all three types of environmental concerns. The picture is less clear with cultural and provisioning services.

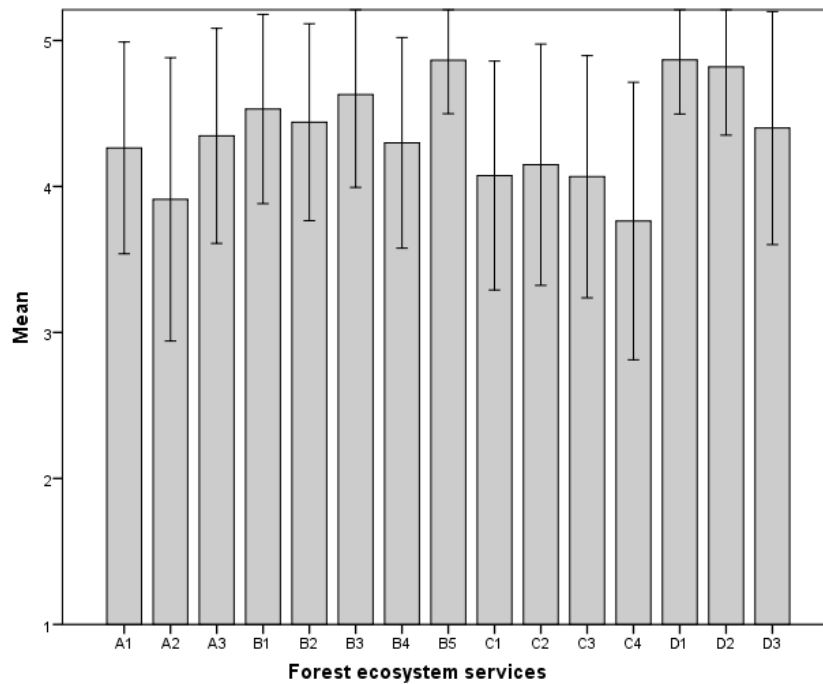


Figure 2. Mean score and standard deviation (error bar) for provisioning (A), regulating (B), cultural (C) and supporting (D) forest ecosystem services; importance assigned by students to services. Specific ecosystem services are described in Table 2.

Table 2. Correlation between students' environmental concern and the importance assigned to forest ecosystem services.

Forest ecosystem services	Concern for self and family	Concern for all the people	Concern for the biosphere
<i>Provisioning services (A)</i>	.077	.166**	.074
Produces timber (A1)	.079	.084	.010
Produces food (A2)	.031	.154**	.133**
Produces fuel (A3)	.070	.098 [†]	-.002
<i>Regulating services (B)</i>	.193**	.252**	.254**
Regulates the climate (B1)	.198**	.167**	.253**
Protects against natural hazards (B2)	.157**	.193**	.102 [†]
Produces clean water (B3)	.144**	.181**	.160**
Soil production (B4)	.036	.153**	.180**
Produces clean air (B5)	.167**	.132**	.195**
<i>Cultural services (C)</i>	.120 [†]	.213**	.162**
Is place to recreate (C1)	.055	.132 [†]	.092
Is place for relaxation and deep thinking (C2)	.076	.152**	.166**
Is place for physical-sport activities (C3)	.124 [†]	.152**	.072

is place of aesthetic value (C4)	.100 [*]	.185 ^{**}	.152 ^{**}
<i>Supporting services (D)</i>	.142 ^{**}	.230 ^{**}	.253 ^{**}
Habitat for animal species (D1)	.077	.153 ^{**}	.292 ^{**}
Habitat for plant species (D2)	.132 ^{**}	.183 ^{**}	.286 ^{**}
Habitat for mushroom species (D3)	.129 ^{**}	.223 ^{**}	.219 ^{**}

Correlation is significant at ^{*} $\alpha < 0.05$, ^{**} $\alpha < 0.01$ (2-tailed).

Students were asked how frequently they visit forests (Figure 3). Half of the students visit forests weekly or multiple times per week. Students were then asked what their most common reason for visiting a forest is. The reasons for visiting forests were divided into four categories of ecosystem services (provisioning, regulating, cultural and supportive) and the category "other". The main reasons for visiting forests fall into the category "cultural services" (80.74%); most of these students use forests for walking, running and relaxation. In the category "provisioning services" (5.43%) students mentioned most frequently logging and mushroom picking. Fresh air is the only reason for visiting forests in the category "regulating services" (6.42%). In the category "supportive services" students mentioned observation of nature, animals and plants (2.47%). The category "other" (4.94%) was formed to include answers such as "do not know" and "scouts".

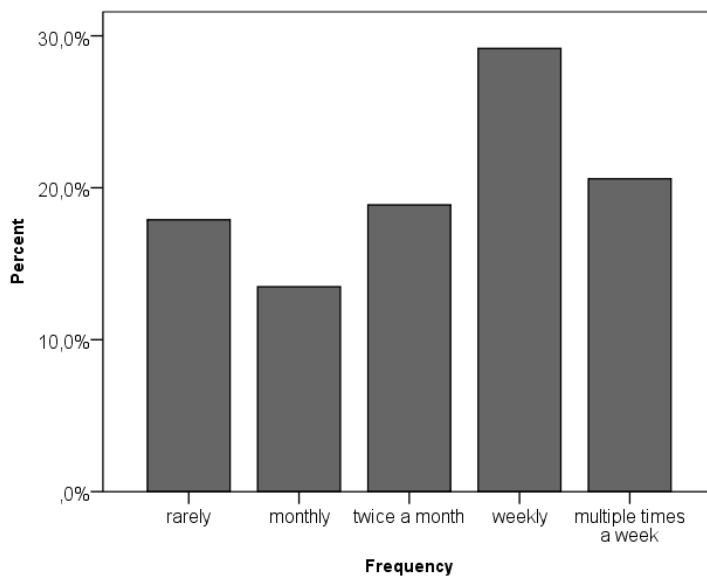


Figure 3. Students' frequency of experiences in forests.

Students with more frequent experiences in forests placed more importance on cultural services; they especially recognized the value of forests as a place to be physically active, to exercise, and for relaxation and deep thinking (Table 3). They also placed more importance on regulating services, especially for the production of clean water and air. More frequent forest visitors also recognized the importance of forests for food production. However, there were no significant differences in students' attitudes for supporting services, like the value of forests as a habitat for animals and plants. No significant correlations were found between different environmental concerns and the frequency of experiences in forests.

Table 3. Influence students' frequency of experiences in forests has on the importance assigned to forest ecosystem services.

Forest ecosystem services	Code	r_s
<i>Provisioning services</i>		
	A	.046
Produces timber	A1	-.047
Produces food	A2	.100*
Produces fuel	A3	-.012
<i>Regulating services</i>		
	B	.113*
Regulates the climate	B1	.107*
Protects against natural hazards	B2	.002
Produces clean water	B3	.126*
Soil production	B4	.078
Produces clean air	B5	.102*
<i>Cultural services</i>		
	C	.214**
Is a place for exercise	C1	.260**
Is a place for relaxation and deep thinking	C2	.175**
Is a place for physical activities	C3	.156**
Is a place of aesthetic value	C4	.043
<i>Supporting services</i>		
	D	.029
Habitat for animal species	D1	.087
Habitat for plant species	D2	.047
Habitat for mushroom species	D3	.017

Correlation is significant at * $\alpha < 0.05$, ** $\alpha < 0.01$ (2-tailed).

Discussion and Conclusion

Students acknowledged the values of ecosystem services provided by forests. They placed the highest importance on supporting services; especially on the value of forests as habitats for animal and plant species. In general, all scores for ecosystem services of forests were relatively high. Our prediction is that this is partly a consequence of the frequent experiences students have with forests – half of the students report being in the forest weekly or multiple times per week.

People around the world are generally concerned about environmental problems because of the consequences that result from harming nature, but they differ as to which consequences concern them the most (Schultz, 2001, 2002). Our findings show that students were most concerned for their health, family and the future of their children, followed by concern for all living beings and animals. Next in the research, environmental concern items were subjected to factor analysis. Findings show that concern for the consequences of environmental damage formed three correlated factors organized around the self and family, all people and the biosphere. These three concerns are comparable to egoistic, altruistic and biospheric concerns, as suggested by Schultz (2001). Female students were significantly more concerned for all people and for the biosphere than male students.



The main objective of the study was to explore the relationships between different types of environmental concerns and attitudes toward forest ecosystem services. Value-based theory (Stern & Dietz, 1994) suggests that concerns about specific environmental issues and pro-environmental actions occur in response to personal values and due to harmful consequences to a value or valued object resulting from environmental problems. Results suggest that students who recognized the high value of regulating and supporting forest ecosystem services also expressed high concern for the consequences of environmental problems; concern for the biosphere, for self and family and concern for all people positively correlated with regulating and supporting ecosystem services of forests. The importance placed on different provisioning and cultural services varied among students with different types of environmental concerns.

Theoretical and empirical studies often suggest high importance of outdoor learning for students' cognitive, affective, physical and social development (Rickinson et al., 2004). Research findings also show that students' frequency of direct experiences in forests is in a significant positive correlation with the value students assigned to some ecosystem services of forests, cultural services in particular. This result was expected, since they are more frequent users of the ecosystem. Students with more frequent experiences in forests also placed more importance on regulating services and food production. This can be explained with their argumentation for visiting forests, where they emphasized fresh air and mushroom picking as frequent reasons for visiting forests. Awareness of the importance forest ecosystem services have could also be influenced by primary and secondary school education that deals with the forest as a primary teaching material in ecology topics, but this should be confirmed with further studies.

Caution should be exercised in generalizing the results of this study because only secondary school students from one region in Slovenia were considered. Nevertheless, the findings and methodological approach could be a useful basis for further research of students' attitudes towards forests or other ecosystems.

Implications for Biodiversity Education

Since humanity is facing challenges in balancing our demands and ecological limitations, the results of this study could be beneficial for further development of biodiversity education. Gayford (2000) emphasized that biodiversity education deals with a complex issue from a number of different perspectives, some scientific and others non-scientific. Biodiversity plays an essential role in sustaining ecosystem goods and services, and in avoiding social and economic crises that threaten the world (Zurlini et al., 2008). It is a socio-scientific issue that requires students to take into account these different ideas and arrive at balanced opinions, therefore making it a particularly interesting and controversial issue. It was stressed in the introduction that the concept of ecosystem services is a good communication tool to promote natural ecosystems (Daily, 1997; De Groot et al., 2002). By using ecosystem services frameworks students can learn about and value ecosystem structure and functions, as well as better evaluate human activities that are associated with them. Most importantly, studying ecosystem services in school can help us address critical issues of biodiversity loss.

A comparative case-study from four European countries showed that primary school teachers integrate at least some information on the scientific aspects of biodiversity, but they rarely include the controversial nature of biodiversity conservation in relation to economics, ethics, social and political concerns (Lindemann-Matthies et al., 2009). Using ecosystem services frameworks and elaborated types of environmental concerns can help educators emphasize the attitudes/needs/rights of an individual and of a society to discuss these issues in a cooperative learning environment (i.e. panel discussion, think-pair-share and jigsaw). A social constructivist theory is put forward here as particularly meaningful to enable students "to actively construct their understandings through interaction with the physical and social world" (Kahn, 1999, 50).

Apart from the commonly discussed direct material benefits of ecosystems for humans (i.e. provisioning ecosystem services), regulating and supporting services of various natural

ecosystems should be evaluated by secondary school students in order to understand and conserve biodiversity and landscape diversity. The instrument used in this study can be a useful tool to assess their attitudes toward ecosystem services and use this as starting ground for further school interventions. Photographs with examples of different forest ecosystems could be used as prompt to discuss ecosystem services in the classroom. This approach was also used as a research method by Lindemann-Matthies et al. (2014); they investigated attitudes toward forest ecosystem services in China and Switzerland.

Biodiversity education should not overlook cultural ecosystem services, particularly their diversity and changing nature. Cultural ecosystem services are defined as "nonmaterial benefits people obtain from ecosystems through spiritual enrichment, cognitive development, reflection, recreation, and aesthetic experiences" (MAE, 2005: 29). de Oliveira and Berkes (2014) wrote that human relations with the environment change over time, especially cultural values. Therefore, it is important to address them in terms of changing human values and sustainability. It might be wise to consider using the term (natural) heritage more often in education, to emphasize long term (sustainable) human-nature relationships.

Last but not least, it would be very beneficial for students if their teachers would arrange regular experiences of the world beyond the classroom (e.g. excursions to close-by natural ecosystems, nature camps). Students need regular contact with the natural environment in school context, especially those children who do not have access to nature as part of their everyday lives (O'Brien, 2009).

Disclosure statement

No potential conflict of interest was reported by the authors.

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