What do we need to know to preserve species?

A study of how different education affects environmental behaviour.

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Front page: Kea (*Nestor notabilis)* in Fiordland New Zealand, photo by Martin Andersson, 2015

Abstract

Our planet is facing the largest loss of biodiversity since the extinction of dinosaurs (Chiante, 2016). This great loss will affect our ecosystems which in turn means that humankind and our needs are affected. It is therefore important to know what factors affect the allocation of resources between species. In the future this will decide how the conservation work for different species will turn out. This thesis investigates how studying different subjects at university affects the allocation of resources on species. In the study natural and social science students were compared with each other. The study was built upon three different questionnaires with three presented species. Each species with different attributes regarding market-based economical value and grade of extinction. The results showed that education matters. A species with a high market-based economical value and low grade of extinction got more resources from social science students. Natural science students distribute their resources more equally over the three species. This correspond with previous research in related fields. This might be because the students have a different approach of how environmental problems are to be solved. In order to increase the environmental knowledge and the willingness to prioritize species conservation based on ethical rather than economical reasons is it crucial to incorporate environmental education in every education program.

Keywords: *pro-environmental behaviour, biodiversity, ecosystem services, environmental psychology, valuation*

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1.Introduction

This chapter gives a short introduction of ecosystem services, biodiversity, pro-environmental behaviour and the importance of education.

It was a warm summer day in Sweden and people where not aware that they were to learn about the climate change and the great environmental challenge we stand before. The environmental professor Johan Rockström spoke truthfully about the earth's condition in his summer talk in Swedish radio (Sveriges Radio P1, 2015). With an environmental issue taking that much place in media, you could imagine that people were getting a bit more concerned. This is an example of how knowledge and information may change people's behaviour to a more environmentally friendly. Although, knowledge is only one variable that will decide how environmentally friendly you will act (Gifford & Nilsson, 2014). Allocation of resources to species will determine which one that will receive the most support to survive or which ones who are left to their own destiny. To mend the loss of biodiversity is it important to integrate biodiversity in legislation and study the opportunities and disadvantages of economic valuation of species. (Butchart *et.al.* 2010).

Naeem (et.al., 2009) asks the interesting question what significance biodiversity have to humankind. We are provided by countless of services from biodiversity, e.g. bees who maintain pollination by crops. A service like this is called "ecosystem service" and Fischer *et.al* (2008) defines it as following:

> 'the aspects of ecosystems utilized (actively or passively) to produce human well-being'

We are everyday, consciously or unconsciously, using ecosystem services (Därhart *et.al* 2013). We may not notice the range of ecosystem services we use, but it becomes very clear when they disappear (Naeem *et. al.* 2009). During the last 50 years have humankind abetted to change our planet more than any other force of nature (Butchart *et.al.*, 2010). This has led to loss in habitats and destruction of ecosystems. We are right now living through a sixth mass extinction (Braje & Erlanson, 2013) at the same scale as the extinction of the dinosaurs (Chiatante, 2016). Scientists identified post industrial humans as the prime driver for this extinction, which means that it is not a cause of nature, it is a cause of humans (Braje & Erlanson, 2013). An extinction in this measurements may trigger a collapse in ecosystems and along with it, a great loss of ecosystem services follows (Braje & Erlanson,

2013). An ecosystem service is not only a measurable unit, it can also constitute esthetical values, e.g. the pleasure of taking a walk in a lush park (Davidson, 2013). A species without a monetary value has a so called "non-use value" (Silverton, 2015). These values are aesthetic and makes human life more enjoyable. A species existence value is also rated as an ecosystem service, (MEA, 2005). Many of the ecosystem services we are provided with from nature are nearly impossible to replace with technological solutions (Därhart *et.al,* 2013). Some researchers denounce the valuing of ecosystem services while others think that putting a value on it will communicate about the issues even more (Zabala, 2015).

Cost-benefit analyses and economic instruments have been made to mirror nature and ecosystems services value (Davidson, 2013). When an ecosystem service contributes with more than the economic value will the valuation be insufficient. This because of the non-use value which is nearly impossible to describe monetary (Därhart et.el. 2013; Silverton, 2015). Research does not show any insight regarding if payments and incentives help increasing pro-environmental behaviour (Zabala, 2015). Därhart et.al (2013) suggests informative policy instruments to highlight the importance of ecosystem services. Economic wealth and environmental sustainability does not have to be in conflict (Heath & Gifford, 2006). Some see the world as it is only for humans to use and benefit from, others claim that nature itself have an intrinsic value and does not exist only for us (Davidson, 2013). It is a balancing act. The concept of acting and behaving environmentally friendly is described by the term "pro-environmental behaviour".

> By 'pro-environmental behavior' we simply mean behavior that consciously seeks to minimize the negative impact of one's action on the natural a built world […]
>
> Kollmuss & Agyeman.

The term is widely disputed and researched, many studies have been carried through to find what makes us behave environmentally friendly. Environmental attitude is based on both beliefs and emotions (Pooley & O'Connor, 2000). Our attitude towards the environment will control our environmental behaviour (Kaiser, 1999) which in it's turn is affected by other factors, e.g. education, image, childhood experience, gender, norms, social class and residence (Gifford & Nilsson, 2014). It is not only the attitude that make people behave in an environmentally friendly way. Locus of control play an important role in behavioural change (Richard & Deci, 2000). It basically means that if you feel that you are able to make a change, it will it be easier to actually do it. Other incentives, such as economic benefits or health related issues, can make people take more environmental friendly decisions (Kollmuss & Agyeman, 2002). The main reason why people won't embrace pro-environmental behaviour is the lack of motivation (Zabala, 2015) and the inability to change practiced behaviours (Kollmuss & Agyeman, 2002). Robelia and Murphy (2012) believe that knowledge about environmental

issues is too low, which will make it hard for people to change and adapt a more environmental friendly lifestyle. To make a change in behaviour and lifestyle, is self-determination and intrinsic motivation important (Deci, 2000). If people have the feeling of greater autonomy will their intrinsic motivation increase (Richard & Deci, 2000). It will also be easier for them to trust that their act against climate change or for the environment matters (Heath & Gifford, 2006). Although there are a lot of different environmental problems and having a deep understanding for them all can be a challenge (Robelia & Murphy, 2012).

In general, educated people hold more knowledge about the environment, but this does not automatically mean that they act more environmental friendly (Kollmuss & Agyman, 2010). According to Synidinos (1990) and McKnight (1991) are business and technology students less worried about the environment than other students. While students from Environmental education programmes worry more (Gifford, Hay & Boros, 1982-83). Individuals with the believe that economics is the best way to measure progress and think that free-market based principles are the best will have a lower concern for the environment (Heath & Gifford, 2006). If you do not have the knowledge about a field you tend not to worry about it (Hines *et.al.,* 1986-87). The National Environmental Education and Training Foundation in the U.S. found a correlation between environmental knowledge and pro-environmental behaviour. Many of the environmental problems are hard to understand if you do not have all the background knowledge (Robelia and Murphy, 2012). Environmental knowledge is far from the only factor that plays part in pro-environmental behaviour. Other incentives, such as cultural values and economical benefits may motivate people to act more pro-environmentally (Kollmuss & Agyeman, 2010). This does not mean that they adapt to a more pro-environmental behaviour in every situation. Chawla (1998) performed interviews with professional environmentalist in the U.S. and the results were that it is not a single factor that makes us behave pro-environmental. However, she mentions education as the least affecting factor. (Heat & Gifford (2006) raise the proposal of environmental education and the rewarding outcomes.

The concept of ecosystem services was to identify in what way humans depends of nature (Silverton, 2015). Ecosystem services is not to be confused with ecosystem functions, that are the processes taking place within the ecosystems. Silverton (2015) argues about the fact that monetizing ecosystem services can make species on the line of extinction less popular for conservation. The “use-values” and “non-use values” are equally important to take in mind. There are occasions when a value on an ecosystem service will play an important role but it is also important for decision maker to reveal the times when it is not. (Silverton, 2015) Either if it’s right or wrong to put a monetary value on ecosystem services is it of high importance to know how people from different background allocate the monetary resources.

2. Purpose

This chapter presents purpose of the thesis, question of issue, hypothesis and delimitations.

The purpose of this thesis was to investigate how different knowledge and education affects the allocation of resources. The study was conducted at natural and social science students. The study investigated how they divide and prioritize resources between species that posses some grade of extinction and species that are economically important. The main goal of the study was to find connections between field of studies and resource division. The question of issue is:

- Does the resource allocation differ between the social science students and nature science students?

Along with the hypothesis that social science students will put more resources into a specie with a known economical value.

2.1 Delimitations

The study was limited to natural science and social science students. This because they often are the policy makers regarding resources for conservation work. The main goal was to investigate if there were any connection between field of studies and the allocation. Other factors' in relationship to resources allocation was investigated. The factors were: age, gender, semester, place of upbringing, time spent in nature. The design of the study was delimited to only speak of an "animal species", not what kind. This to keep the questionnaires so impersonal as possible.

3.Method

This chapter covers design and content of the study along with procedure and analysis of data.

3.1 Literature search

The process started with a literature search on Web of science and LUBsearch. The words and constellations searched for was, *valuation*, specie*," economic valuation", knowledge AND valuation AND biodiversity, knowledge AND biodiversity AND valuation, Valuation AND specie* AND environment*,"pro environmental behaviour"*

3.2 The Study

The practical part of the thesis was conducted through a survey on students. The data was collected on paper questionnaires and analysed in IBM SPSS statistics 23. Recipients for the study were chosen based on their field of education. Nature science students had a major in biology, environmental science or geology. Social science students had a major in economics, law or political science. The students were found by going out to lectures and asking them to conduct the study.

3.2.1 The questionnaires

The study was built upon 3 questionnaires, see annex A, B and C. Each with different information regarding the presented species. All of them held a short information regarding ecosystem services and extinction. Questionnaire 1 held information regarding economical value. Species A had a high market-based economical value, species B had a medium market-based economical value and species C hade a low market based economical value. There were no information regarding grade of extinction. Questionnaire 2 held information regarding grade of extinction. Species A had a high grade of extinction, species B had a medium grade of extinction and species C had a low grade of extinction. There were no information regarding the market-based economical value carried out. Questionnaire 1 and 2 were to investigate the insecurity of not having the whole spectra of information. Questionnaire 3 held information on both market-based economical value and grade of extinction. Species A had a high market based economical value and a low grade of extinction, species B had a medium market-based economical value

and a medium grade of extinction, species C hade a low market-based economical value and a high grade of extinction. The questionnaires where tried out on a group of environmental science students before the real survey begun. Their opinions regarding font, transparency and questions where collected and taken in mind when designing the final questionnaires.

3.2.2 Procedure

The students received one of three different questionnaires where they all were asked to divide 100 SEK between three different species. The recipients were asked about age, gender, field and years of education, where they grew up and how much time they spent in nature. These questions where asked to receive a broader picture of their background. The survey did not hold any information about the species, more than it was an animal species. This for the recipients to not get emotionally attached to any of the species and for keeping the study transparent. The time frame for the students was open, they had as much time they needed to finish the questionnaire, however not more than 10 minutes

3.3 Data analysis

All the collected data were analysed with IBM SPSS statistics 23. 9 t-tests were conducted with the allocated resources and field of education. The t-test to find out if there were any significant differences between the means. In the cases where significance was found was a multiple linear regression conducted. This regression was used to find relationships between the dependent variable, resource allocation and the independent variables, field of education (x_1), years of education (x_2) age (x_3), gender (x_4), time spent in nature (x_5), place of upbringing (x_6).

$$Y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 \ldots + \beta_n x_n + \varepsilon \qquad (1)$$

Equation 1 describes the linear multiple regression, Y is the dependent variable, x_n is the independent variables, β is a regression coefficient and ε is a stochastic variable. It is also important to look at the independent variables homo or heteroscedacticy to see if there are any subgroups of variance

4. Results

This chapter will present the relevant results from the study.

171 questionnaires were turned in, 66 from nature science students and 105 from social science students. Some of them were not fully filled out but the existed data was used in the cases were it was possible. The ages were from 19-38 and gender distribution, 111 females and 54 males.

Table 4.1 show distribution of education within the fields.

Natural science	n	Social science	n
Biology	2	Economy	86
Environmental science	62	Political science	18
Ecology	1	Law	1
Geology	1		
Total	66	Total	105

Table 4.1 show that environmental science is the most represented in nature science and economy in social science. The following results are the ones most valid for the discussion. The independent t-test regarding age and semester did not show any significance, neither did the x^2 test concerning gender balance or the Mann-Whitney test on time spent in nature and place of upbringing. This means that the recipients were alike in all of these variables.

Table (4.2) Results from t-test conducted with data from questionnaire 1, where only species economical value was known. A has a high economical value, B medium and C low.

		A		B		C	
	n	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Natural science	20	48,95	15,32	29,15	9,44	21,9	7,85
Social science	32	57.03	21.59	24.22	11.37	18.75	18.23
P- value, sig.			0.064		0.143		0.093

There was not any significant difference between the students allocation in the questionnaire that held information regarding market-based economic value (table 4.2). However, the social science students had a higher mean value on the species with a higher market-based economic value.

Table (4.3) Results from independent t-test conducted with data from questionnaire 2, where only grade of extinction was known, A equal high risk, B medium risk and C low risk.

		A		B		C	
	n	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Natural science	21	60.24	13.92	28.57	8.39	11.19	7.58
Social science	33	65.45	12.20	26.52	8.24	7.79	7.09
P- value, sig.			0.800		0.745		0.981

No significant difference was found between the allocations when the recipients had information about the grade of extinction, the mean values were similar (table 4.3).

Table (4.4) Results from independent t-test conducted with data from questionnaire 3, where grade of extinction and market-based economical value were known. A equals a high market-based economical value and a low risk of extinction, B equals a medium grade of extinction and medium market-based economical value, C equals a low market-based economical value and a high grade of extinction.

		A		B		C	
	n	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Natural science	21	13.81	9.86	34.52	12.93	52.73	15.64
Social science	34	30.5	23.72	27.06	10.81	42.44	20.31
P- value, sig.			0.019[a]		0.350		0.321

[a] indicates significance, p<0,05

A significant value is found in table 4.4. The social science students allocated more resources in to the species with a high market-based economical value than the natural science students did. This data was further investigated trough a multiple linear regression.

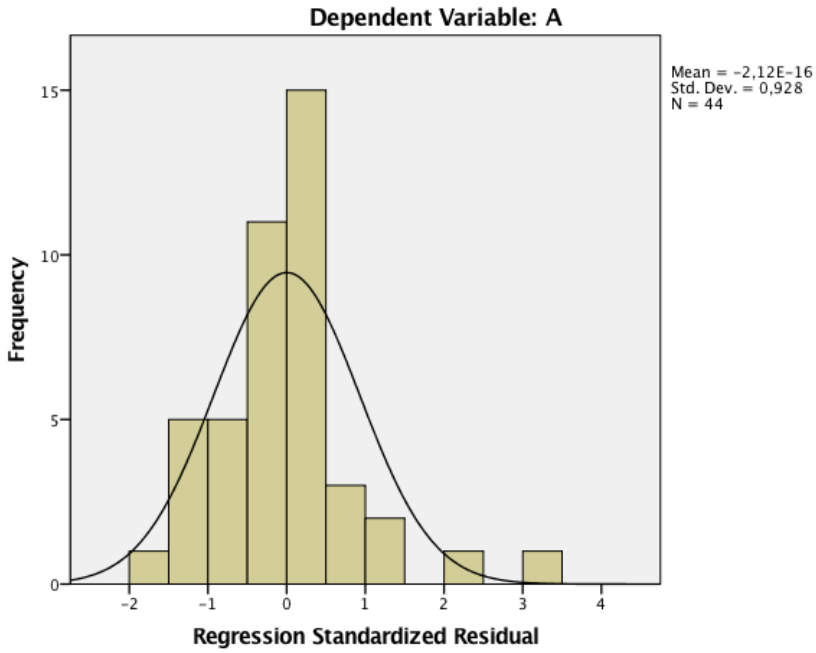
Table (4.5) Results from linear multiple regression conducted with data from questionnaire 3 and specie A. Variable is the independents variables, B is is the parameters of the independent variables, std. error tells how much the parameters differs from the mean and significance shows if the parameters are statistically significant (p<0,05).

Variable	B	Std. error	Significance
Intercept	16.36	36.04	0.653
Education	16.97	6.51	0.013*
Age	-0.61	1.67	0.717
Gender	15.41	7.81	0.056
Semester	-0.83	1.94	0.672
Place of upbringing	-2.46	3.06	0.427
Time spend in nature	2.01	4.59	0.665

[a] indicates significance, p<0,05

Table 4.5 shows how much the independent variables affect the dependent variable which in this case is resources allocated to specie A on questionnaire 3. A species with a high economical value and a low grade of extinction. The only significant variable is 'education'. The social science students put 16.97 SEK more into this species than the nature science students.

Figure 1, Histogram showing the distribution of the regressions residuals.



Hetero- and homoscedasticity describes if the residuals are spread out constantly or not. If heteroscedasticy occurs will the independent variables affect each other and influence the regression outcome. The residuals in questionnaire 3, species A (table 4.5; figure 1) were tested and homoscedasticy prevailed, the residuals were not affected by one another.

5. Discussion

The following chapter will discuss the results presented in previous chapter.

The main goal for this study was to find connections between field of education and allocation of resources. The results showed differences and answered the question of issue. There was a difference in resource allocation whereas one result was significant (table 4.4; figure 4.1). The significant difference was shown on the specie with a high market-based economic value and low grade of extinction. The social science students put more money into this specie while the nature science students put less. This confirmed the hypothesis that social science students benefits species with a high market-based economic value rather than endangered species. So why is this? As the social science students mostly studied economy (table 4.1) will they answer the question founded on what they have learned. Nothing else than education showed significant difference in the regression (table 4.5; figure 4.1).

The results from questionnaire 1 and 2 (table 4.1 and 4.2) showed difference in mean value of allocation. Questionnaire 1 held information about the species' market-based value and questionnaire 2 about the grade of extinction. Other information was unknown. This created a situation where the students had to value known information compared to unknown. The natural science students tend to hedge themselves more and allocate the resources more equally over the all three species in all three questionnaires. While the social science students focus more on the most endangered or the one with highest market-based economic value. The social science students were more likely to take risks while the natural science students protected themselves from the uncertainty. The majority of the natural science students will sometime during their education take a paper about economy or law, this makes them look at problems from many different directions. While the social science students are more narrow in their field of studies and might not have taken into consideration of all three species in questionnaire 1 and 2. If there is a lack of knowledge in a subject will the students be less about it (Hines et.al. 1986-87; Robelia & Murphy, 2012). The outcome of the study is affected by norms; students may have divides the resources based on what they feel are expected of them. Norms are considered of a determining factor of pro-environmental behaviour (Gifford & Nilsson, 2014). Norms are also a question of moral obligation. If the students feel required to take action and make a stand (Gifford & Nilsson, 2014) for either of the species presented. Even though they received different questionnaires could they have talked among themselves and some students might have felt peer pressure and forced to answer as the rest.

So why not any more significant differences? All students live in the same city, study at the same university and were all Swedish. As the regression (table 4.4; figure 4.1) show were education the only significant difference between the students. This makes them a quite homogenous group to conduct a study on. This study was chosen to be carried out to students because the aim was to find differences in education and knowledge. The questionnaires were designed not to make the students emotionally connected to the species. The species were only presented as an 'animal species' which only the students imagination may decide on what kind. The results confirmed the hypothesis but in a more detailed study could it be a better design to have different species, this would make it easier for the recipients to form an opinion and gain interest.

Robelia & Murphy (2012) write of the different environmental problems and that it could be hard to hold knowledge about them all. One of the greatest environmental issues right now is the loss of habitats and species. But to only preserve a specie based on it's economical value will put the biodiversity and endangered species as a less concerned factor of the changeable markets and new technology (Silverton, 2015). It is impossible to only value species and ecosystems only after what they contribute with to humankind. They themselves hold an intrinsic value and a right to thrive at our planet. The non-use values they contribute with to us makes human life much more delightful. (Silverton, 2015) is impossible to value. As Kollmuss & Agyeman (2010) proclaims may it be an idea to make biodiversity and species to a monetary question, this may lead to that people care more. Silverton (2015) on the other hand, argues that not all biodiversity and nature should have a set price. While put a price on the measurable ecosystem services, destruction and pollution (Silverton, 2015) of nature might be a better solution.

6. Conclusion

Education matter. Regardless of what different scientists imply have this study confirmed that education will affect how resources are allocated to different species. There is a significant difference in how social science and natural science student allocate the resources. Social science students will put more money in species with a high market-based value. Natural science students tends to spread out the resources more equally over the species even when uncertainty prevails.

Global climate change is occurring, one by many disasters will be great loss of biodiversity. Many of the future policy makers are the ones participating in this study. For this reason, is it crucial to hold knowledge about how these different groups divide resources for conservation work. The species most important for humans might not be the ones most important for the ecosystem functions. And what will happen when more and more habitats go lost? More and more species will disappear. This study tells us that even social science students should have environmental education. All knowledge is good knowledge and if the information about environmental issues got more widespread would it be easier to defend our planet against coming disasters.

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Annex A
Questionnaire 1

Ålder				
Kön	Kvinna	Man	Vill ej uppge	
Vad studerar du (huvudämne)?				
Vilken termin är du på?				
Var växte du upp?	Landsbygd	By	Småstad	Stad
Hur mycket vistas du i naturen?	Aldrig	Någon gång per år	Någon gång i månaden	Någon gång per vecka

Ekosystemtjänster
En djur- eller växtart kan generera marknadsmässigt ekonomiskt värde genom att till exempel pollinera grödor, hålla borta skadeinsekter från åkerfält, locka turister eller rena vatten. De kan även vara oss till nytta genom att berika vårt friluftsliv. Vissa arter bidrar med stora marknadsmässigt ekonomiska värden medan andra bidrar med mindre. Dessa tjänster som vi människor har nytta av kallas för ekosystemtjänster.

Hotade arter
När en hel arts fortlevnad hotas brukar man säga att den är utrotningshotad. En vanlig anledning till varför arter blir utrotningshotade är att området de lever i förändras eller förorenas av människor.

Du har totalt 100 kr som du ska lägga på att hjälpa till med att bevara och öka antalet av tre olika djurarter. Du väljer själv hur du vill fördela pengarna mellan djurarterna A, B och C, baserat på informationen nedan.

Art A har ett högt marknadsmässigt ekonomiskt värde. Det är okänt om arten är utrotningshotad:

_____Kr

Art B har ett medelstort marknadsmässigt ekonomiskt värde. Det är okänt om arten är utrotningshotad:

_____Kr

Art C har ett litet marknadsmässigt ekonomiskt värde. Det är okänt om arten är utrotningshotad:

_____Kr

Annex B
Questionnaire 2

Ålder				
Kön	Kvinna	Man	Vill ej uppge	
Vad studerar du (huvudämne)?				
Vilken termin är du på?				
Var växte du upp?	Landsbygd	By	Småstad	Stad
Hur mycket vistas du i naturen?	Aldrig	Någon gång per år	Någon gång i månaden	Någon gång per vecka

Ekosystemtjänster
En djur- eller växtart kan generera marknadsmässigt ekonomiskt värde genom att till exempel pollinera grödor, hålla borta skadeinsekter från åkerfält, locka turister eller rena vatten. De kan även vara oss till nytta genom att berika vårt friluftsliv. Vissa arter bidrar med stora marknadsmässigt ekonomiska värden medan andra bidrar med mindre. Dessa tjänster som vi människor har nytta av kallas för ekosystemtjänster.

Hotade arter
När en hel arts fortlevnad hotas brukar man säga att den är utrotningshotad. En vanlig anledning till varför arter blir utrotningshotade är att området de lever i förändras eller förorenas av människor.

Du har <u>totalt</u> 100 kr som du ska lägga på att hjälpa till med att bevara och öka antalet av tre olika djurarter. Du väljer själv hur du vill fördela pengarna mellan djurarterna A, B och C, baserat på informationen nedan.

Art A löper stor risk att bli utrotad. Artens marknadsmässiga ekonomiska värde är okänt:

_____Kr

Art B löper mellanstor risk att bli utrotad. Artens marknadsmässiga ekonomiska värde är okänt:

_____Kr

Art C löper liten risk att bli utrotad. Artens marknadsmässiga ekonomiska värde är okänt:

_____Kr

Annex C
Questionnaire 3

Ålder				
Kön	Kvinna	Man	Vill ej uppge	
Vad studerar du (huvudämne)?				
Vilken termin är du på?				
Var växte du upp?	Landsbygd	By	Småstad	Stad
Hur mycket vistas du i naturen?	Aldrig	Någon gång per år	Någon gång i månaden	Någon gång per vecka

Ekosystemtjänster
En djur- eller växtart kan generera marknadsmässigt ekonomiskt värde genom att till exempel pollinera grödor, hålla borta skadeinsekter från åkerfält, locka turister eller rena vatten. De kan även vara oss till nytta genom att berika vårt friluftsliv. Vissa arter bidrar med stora marknadsmässigt ekonomiska värden medan andra bidrar med mindre. Dessa tjänster som vi människor har nytta av kallas för ekosystemtjänster.

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Art A har ett högt marknadsmässigt ekonomiskt värde. Art A löper liten risk att bli utrotad:

_____Kr

Art B har ett medelstort marknadsmässigt ekonomiskt värde. Art B löper mellanstor risk att bli utrotad:

_____Kr

Art C har ett litet marknadsmässigt ekonomiskt värde. Art C löper stor risk att bli utrotad:

_____Kr

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