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'Pricing Nature at What Price?' A study of undergraduate students' conceptions of economics

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Abstract

This paper focuses on undergraduate students' conceptions of, and learning in, economics. Reviews in the field of environmental education research have made clear that insufficient attention has been paid to the question of learning. In particular, there have been very few empirical investigations into the process (as opposed to the outcomes). There has also been a failure by environmental education researchers to engage with learning theory. Furthermore, it has been concluded that little research conducted within the realm of social science has included issues that relate to the environment in comparison to research in the natural sciences. In the light of this situation, this paper reports findings from a research project on undergraduate students' learning in economics and environmental science, focusing in particular on conceptions of learning in economics. The results show that, among a group of 11 students entering a masters course on Sustainable Enterprising at Stockholm University, a majority of the students having a major in the natural sciences found economics to be challenging in various ways. All the students addressed the concept of 'price' as particularly challenging as it does not give 'accurate' value to nature and resources. The paper ends by discussing the students' conceptions of the subject and reflects on challenges for learning in general when topics and content are found to be in conflict with personal values.

Introduction

In the research on environmental education, natural science has been regarded as the most important knowledge domain and several studies have focused on students' understanding of natural scientific phenomena (e.g., Boyes & Stanisstreet, 1998; Ivy, Lee & Chuan, 1998). However, there is a growing number of courses, particularly in higher education, focusing on environmental and sustainability issues in disciplines such as business and economics, law and history. Outside the academia, economics relating to environmental issues and problems is gaining more and more interest. An example of this is the attention the Stern Review from the UK's economics and finance ministry received in the Swedish media when presenting the costs (an estimation of 5 000 billion euros) of global warming (Stern, 2006).

With some exceptions, little research conducted within the realm of social science has included issues and matters that relate to the environment (c.f. Torney-Purta, 1994, on students' conceptual understanding of politics and economics concerning environmental issues). In a recent review on learners and learning in environmental education, it was concluded that insufficient attention has been paid to the students' socio-political knowledge and understanding

in comparison to their scientific knowledge (Rickinson, 2001:307).

This paper focuses on the conceptions of economics of undergraduate students with backgrounds in biological and environmental education. First, previous research on students' experiences of learning and research concerning 'troublesome knowledge' is presented. Then the findings of a case study exploring students' conceptions of economics and the pricing of nature are presented. The paper ends with a discussion on challenges for learning in terms of cognitive, meta-cognitive and affective aspects.

Background

Research on students' experiences of learning in higher education has been evident for some 30 years. One of the basic research questions addressed is how students conceive of the learning situation and what aspects they see and attend to as significant and how these relate to prior experiences of learning (Prosser & Trigwell, 1999). The major issues investigated empirically concern students' different ways of approaching studies and the relation to learning outcomes (Marton & Säljö, 1976; Meyer, Parsons & Dunne, 1990; Prosser, Hazel, Trigwell & Lyons, 1996; Entwistle, 1998), students' perceptions of the subject matter and approaches to studies (Crawford, Gordon, Nicolas & Prosser, 1994) and different understandings of key concepts, such as 'price' in economics (Dahlgren, 1984). This research points to the fact that students' prior knowledge of key concepts, prior experiences and conceptions of the nature of the subject matter, and prior experiences of studies of that subject, are aspects that are evoked in a new learning situation.

Research on higher education in recent years has paid special attention to the knowledge content and domain-specific concepts that students encounter in the learning situation (Meyer & Land, 2006). In this research the term 'troublesome concept' is used, referring to concepts that make the student 'see things in a new way' and is, as such, transformative. Meyer & Land (2006) explain that 'a threshold concept is thus seen as something distinct within what university teachers would typically describe as "core concepts"' (*ibid*.:xv). But, more so, threshold concepts are often troublesome for students to learn, and Perkins (1999; 2006) describes 'troublesome knowledge' as being conceptually difficult, counter-intuitive or 'alien'. Foreign or alien knowledge is knowledge that 'comes from a perspective conflicting with our own' (Perkins, 1999:9). In the subject of economics, an example of alien knowledge is presented by Shanahan & Meyer (2006):

> It is not uncommon in introductory economics courses to encounter students who reveal their 'anger' or 'disbelief' in the approach taken by the discipline. They just don't 'believe', for example, that it is appropriate to put prices on say, wildlife, or that 'some' pollution may be acceptable if the benefit from the activity causing the pollution exceeds the pollution costs. This may be despite students agreeing that such approaches can serve to achieve objectives consistent with their original beliefs (such as wildlife preservation). In the extreme, such resistance to an 'alien' approach can result in the student withdrawing from the course. (p.104)

Another way of looking at what can be regarded as troublesome knowledge or concepts is the notion of *episteme* within different disciplines. Knorr-Cetina (1999), in studying the research practice of physics and biochemistry, describes these systems in terms of 'epistemic cultures', and, in the words of Perkins (2006), an episteme can be defined as a 'system of ideas or ways of understanding that allows us to establish knowledge' (p.42). Davies (2006) gives a description of economics, stressing the aspect of systems thinking, which also can be seen as the episteme of the subject:

> For example, the economist's conception of a system of interactions between idealised individuals and producers encourages the application of mathematics to formally model ultimate outcomes. Abstraction from the peculiarity of any one individual or producer is necessary in order to make it possible to examine outcomes from many interactions that do not simply replicate the outcomes that would arise from one producer and one consumer. (p.79)

The research on students' conceptions of the nature of knowledge has its origin in the much-cited work by William Perry at Harvard University (Perry, 1970/1999). The results from his longitudinal study concluded that students develop their understanding of knowledge in a scheme: from a view of duality of knowledge, being right or wrong, to a view of multiplicity, finalising in an understanding that knowledge is constructed in shared norms of inquiry and knowing. In the finalising phase the student comes to a notion of 'commitment', meaning that the student decides on a theoretical perspective or means of inquiry, for different reasons. Thus, the student makes a choice, and 'commitment' refers to an act of awareness.

The study presented here is part of a current research project exploring how students come to learn in a new field – environment or economics – depending on their educational background being in environmental/biological science, or business and economics.

Methodology

Interviews were carried out with 11 students who were in their first week of a masters course on Sustainable Enterprising in January 2005. As part of the course requirements, the students needed a degree either in economics or in biology, with a complementary of 30 ECTS points in biology/ecology or economics, depending on their chosen major. The 11 students included 2 students with degrees in economics, and among the remaining 9 students, 4 had studied different inter-disciplinary environmental programmes (environmental communication, ecological economics, environment and sustainability) and 5 had a degree in biology followed by courses in economics.

The following interview questions were posed:

- Why have you chosen this masters course?
- What is your professional and educational background?
  - If you have a degree in biology or environmental science, what was your experience when entering the subject of economics?
- How do you see the relation between economy and environment?

All students were interviewed individually, and with informed consent from the students all interviews were tape-recorded and transcribed in full. The analysis of data focused on the students' descriptions of economics and on their ways of studying and learning, with a particular emphasis on how the students talked about pricing nature. The results of the analysis, presented in terms of students' conceptions, draw on inferences made from an intentional perspective (e.g., Halldén, 1999; Halldén, Haglund & Stromdahl, 2007; Lundholm, 2003; 2004a; 2004b; 2005). This means that the students' interview answers must be considered as part of a social context. For example, the students' responses can be seen as forming part of a conversation with the interviewer, or as part of a test situation in which the student tries to give a 'correct' answer, or both. The idea of taking the social setting into account is to facilitate an empirically grounded analysis that takes not only cognitive, but also discursive, aspects into consideration, thus strengthening the validity of the interpretations made of the students' conceptions.

Results

Among the nine students with a degree in biology or environmental studies, four students conceptualised the manner in which economics excludes nature, and how nature was accounted for when included, as problematic. Two students had not experienced conflicts in their studies, although one of them also found the limited view of nature in pricing unsatisfying.

In the following section, excerpts from the interviews concerning the students' views on economics and economical concepts are presented. The views of four students (Anna, Beatrice, Cornelia and Diana), who found concepts such as 'price' problematic, i.e., not taking into account nature and limited resources, are presented first. These are then followed by the views of two students, Erica and Fanny, who found the subject of economics important as it widened their understanding of environmental problems and the business world.

Student 1: Anna

Anna described her experiences of studying economics and the way she was trying to create an integrated 'picture', also stating she did not have much interest in economics.

> *A: After studying natural science I did economics this autumn, and I'm just beginning to realise how it can be integrated to work in an optimal way, I'm not quite there yet. I mean, I haven't got a clear personal picture, I know they have to be combined, but how, what, no, I really can't say.*
>
> *C: How do you mean, what do you think is difficult?*
>
> *A: Because I really don't have much of an interest in economics, my interest is in the environment, and I think it's the same for all natural scientists, having trouble handling the economic part which is compulsory.*

In the last sentence above, Anna is referring to the requirements for entering the masters course Sustainable Enterprising.

Pricing nature. The challenges in studying macroeconomics described by Anna concerned the pricing of nature. She found that the monetary values ascribed to nature were 'minimalistic' and did not include ecosystems services.[1] This can be interpreted to mean that *what* is included and calculated concerns only parts or certain aspects of nature or natural phenomena, which is not accurate or 'enough' according to Anna.

C: You began by describing a way of thinking in the subject, what did you mean?

A: Well, you have to think in terms of money all the time. Not values or something like that, but the fact that everything has to be shown in dollars and cents when a decision is to be made, and my worldview really opposes that.

C: Is it because you can't price everything in dollars and cents?

A: No, it's difficult, you have to price everything because the world is governed by economy, sadly enough, so you have to price it otherwise these economists won't understand. It's difficult for me because often enough the value you put on nature is minimalistic, the real values are so much higher, and so often they are valued less than they should be. But there is no one that can do it, it's personal values that give nature a value.

C: Is it? Personal values?

A: Actually, yes, no, but these minimalistic accounts people have done, they are only based on the loss of certain ecological services.

Anna described her difficulty with pricing nature, in terms of not being able to include everything that she found valuable, several times. When Anna carried out a task in environmental economics with a student who had not studied biology, she became aware that her way of viewing nature, and how it should be accounted for, differed from those of a classmate.

C: This task you worked on, pricing a meadow, why is it important to save the meadow?

A: For example, when you maintain biodiversity, you maintain resilience in nature, and it's important to avoid monocultures because then you have the risk of getting noxious insects that will destroy everything completely. /…/

C: But your fellow student, she could also have tried to price the meadow?

A: Yes, but it's not part of the way they do pricing, perhaps they don't…, I don't know. You have to have knowledge regarding ***what*** *to take into account, what is known as valuable. But of course there's been progress, in environmental economics, and that's very good.*

When asked if the 'economic system somehow could "marry" the natural system', she replied:

A: Well, it will work if you want it to. Because, we get ecological services from the environment, and if we use them properly it can work. But, also, there can't be too high expectations on economic growth and things like that. You have to adjust to the thought of things working in a reasonable way, not maximising profit.

Student 2: Beatrice

'The environment' as 'externalities' in classic macroeconomics. In the course on macroeconomics that Beatrice attended, concepts such as nature and environment only featured in the curriculum in terms of 'externalities'.[2] However, when writing an essay in the field of environmental economics, which was optional, she became aware that valuing nature monetarily was a way of accounting for nature.

B: When I studied macroeconomics, environment wasn't something that was mentioned in lectures, the environment and limited resources isn't something that is taken into consideration, it's only addressed as externalities – increasing of costs. So, with this essay we wrote in environmental economics we really came to understand that you can value the environment in some way, that you really can't, but perhaps must do, in order to make people realise it has to be conserved, that is actually costs something.

C: What do you mean, 'that you can value the environment in some way, that you really can't, but perhaps must do'…?

B: Because, well, the way society works, it's all about economic growth and maximising the economy as much as possible, and in order to make the people who take care of and work with economy [understand] you have to price nature, that's the language they'll understand. So, if you price nature they'll understand that it costs.

Pricing nature. Beatrice, like Anna above, also described the difficulty of pricing nature. Here she is addressing the problem of ascribing an appropriate value when there are several stakeholders and presumed interested stakeholders.

B: It's very difficult to price nature and there's no procedure that will capture all values, somehow. It's difficult…

C: What is not captured?

B: Well, take my example with the owners of camping grounds on the island Öland, we valued how much their cost of production would increase by taking away all the algae on the beaches [in order to attract campers and caravans], and the values that are not included [are] for example how much the people living by the beaches valued the environment, and people who come there for the day. Now

there was simply an increase in costs of production. And people might come there anyway; there are all these different aspects…

C: You mean it's not estimated how other groups of people value the beach?

B: No exactly, and furthermore, you don't consider what it's worth for a seagull, having a clean beach. I mean animals, such values, what's it called – existential,[3] I'm not sure, but values that are not in the interest of humans, but for, say, animals…

Student 3: Cornelia

Cornelia has conducted studies in a programme entitled 'Environment and Development', where the need for interdisciplinarity and understanding different ways of conceptualising the world was often stressed. As part of the programme the students studied economics, but these courses were not introduced at the start of the programme and Cornelia describes the tensions the class experienced in relation to the environmental courses.

C: [We studied] classic and neoclassic economics and the teacher was almost personally accused and attacked, we said 'but why does it look like that, it shouldn't be like that!'. And the teacher replied 'but it's a theory, it's not evil in itself'. There was a really harsh atmosphere in the whole class – 'you have to consider the environment'. So, there was a clash the first time we were presented to the pure, classic theory of economics. But eventually during the course we talked about how different systems are connected and so on, but in the beginning… /…/ As time went, well, I guess the teacher wanted that reaction, and in the coming lectures he stressed that 'this it is not a matter of right or wrong, it's a theory, none is better than the other' and he presented several theories.

The environment as 'marginal costs'[4] in classic macroeconomics. As indicated above, Beatrice mentioned the concept of 'externalities' as problematic in describing the account of nature in economics. Cornelia found the term 'marginal cost' to be similarly problematic.

C: Neoclassic and classic economics doesn't consider the environment, instead they do economic calculations on the marginal costs, but then I asked 'for what reason?'

CL: You mean environment is part of the models as a marginal cost?

C: Yes, exactly, it was like this, 'well, how much does it cost to produce this unit?' 'What's the demand, supply' – and all of that. The environment wasn't really considered, wasn't included, as something in its own right.

What Cornelia is referring to when saying 'in its own right' is not obvious. The issue she might be addressing is if and how nature is included in theories of economics.

Pricing nature. Cornelia, like Anna, addressed the services that nature provides that are important but not accounted for, and Cornelia discussed the problems related to the term 'tragedy of the commons'.

C: I think it's problematic how to price, well let's talk about cows again, the cow's ability to produce milk, or to estimate value of the park outside, how to price it. I think that's the most difficult thing.

CL: But what makes it so difficult?

C: These big ecosystems services from the ocean and the air, nobody owns that. The rights of owning are perhaps limited to, what's it called, a fishing certificate, and there's…

CL: Are you referring to the tragedy of the commons?

C: Yes, exactly

CL: Okay, and there's no ownership, no selling and buying, so how to find a value…

C: and no obligations and no rights /…/ You have to, in the end, create a win-win situation, and that's not so easy.

Student 4: Diana

With a bachelor's degree in biology, Diana studied macroeconomics at Stockholm University with the aim of entering the masters course Sustainable Enterprising. In talking about her experiences she described the way she perceived the economic view of nature, as opposed to her own.

C: When you say there's an ideological difference, what do you mean?

D: The difference is that the economists often think there is a 'base' that is in the economic world, or possibly in the social world, while we who have studied biology see the economic and social world depending on ecology as a foundation. So, it's the opposite really, the world up side down /…/ The way I see it, nature constitutes the base, we are part of nature and through nature we get economy, that is, what is traded is taken from nature, it's not something that's just there like magic in a factory, it has its origin in nature. I think that's why I found it very difficult in economics – they picked out the environment part, and sort of put it on the side, like an appendage, instead of the way I see it – as the foundation for everything. Because, if nature wasn't there, we wouldn't be here ourselves.

Pricing nature. Diana finds pricing impossible and even 'dangerous' since aspects such as time and change may not be possible to account for. She also talks of a resource such as air as being 'invaluable' since it is the foundation of life; if there's a loss it's irreplaceable.

D: I don't think everything should be given monetary value, it's actually impossible to do I think. It's more of a thought experiment, it might even be dangerous to do, since you have to take time and change into account. It can be terribly misleading. But also, it's very individual. That is, what value you give, it depends on who you ask.

C: You mean estimating value by asking people around, for example, a forest or recreation area?

D: Yes, exactly, it depends on how you look at it. A forest for example, you have the landowner, the owner of the forest, the forestry company, and the people who use it for recreation, so it's impossible to find…

C: Have you considered pricing in relation to common resources?

D: Some things are invaluable in a sense, so of course it's very difficult, but still you have to do it, I don't know…

C: What do you mean by invaluable?

D: Well, they're the foundation for life, you can say, if those things don't work, then there's nothing, no people either. If we destroy the air for example and there's no air to breath we can't live so that's invaluable. It's valuable in a very special way.

The views of the students presented above indicate that they saw their economics studies as challenging in various ways. In the following section two students' views are presented. They conversely, instead, found the subject valuable in the positive way it challenged previous ideas and added knowledge in relation to a business context.

Student 5: Ester

Ester did not give any accounts of perceiving difficulties in encountering the subject of economics. Instead she related the subject to her knowledge or worldviews from environmental courses and said:

E: In one way I think, since I had only taken environmental courses, we see things in a simplistic way. /…/ Us, on the 'nature side'. It's not as easy as I thought; you can't just stop cutting down the forest, or simply stop fishing, because we want to conserve nature. You have to get the economy going to make the social life work; perhaps one way to see it is as a social ecological system and to see it as interrelated. If the social system doesn't work, the ecological doesn't work either.

Ester gave a description of the views students hold of each other in the subjects of biology and economics, and here, she is probably referring to the different professional groups as well.

E: I feel there's a conflict between economists and biologists. They look at us thinking, 'you don't know how things ***really*** *work, and without the economy society wouldn't function'. But we look at them as those people who destroy for us. I really want to know how they feel, sort of, and in that way incorporate the two disciplines, and be able to work towards the same goals.*

Student 6: Fanny

Fanny was the other student, apart from Ester, who also found the studies in business and economics to be of a positive kind.

F: There's not been any conflict due to my natural scientist background. Rather, I've realised that it's a tool you need to be able to work in a company and understand how the whole company works. /…/ My picture of environmental work is having this narrow focus, while I want to be part of budget planning and do understand the need of maximising profit.

Pricing nature. Fanny answered the question on how she perceived pricing nature with discussing the use of pricing, as the world is 'too complicated'. She also mentioned the finiteness of resources being important to consider:

F: Personally, I don't think you can use economics all the way, because the world is much too complicated, for example the natural resources will come to an end – there's a big conflict. I mean, how is that dealt with in economics?

Summary of Findings

Anna and Cornelia's conceptions of studying economics are clearly of a challenging kind. Anna seems to be mainly interested in the environment and found it problematic that '*everything has to be shown in dollars and cents when a decision is to be made, and my worldview really opposes that*'. Yet, she is eager to learn and tries to combine her biological knowledge with economics. Cornelia, and her class, came into conflict with their lecturer regarding the way nature is not taken into account in economics theories. Diana also described the clash with the subject in terms of what is considered as 'base' in the subjects of biology and economics. Encountering economics meant 'flipping the pyramid' and considering nature as an 'appendage' and not as a foundation. However, two other students, Ester and Fanny, found no such challenges in studying economics. On the contrary, Ester considered her environmental studies and viewpoints in the light of economics and revised them as being 'simplistic'.

Regarding conception of pricing nature, it is perceived by all but one student as difficult, insufficient or even 'dangerous'. Their argument is that resilience (Anna), ecosystem services (Cornelia and Diana) and limited resources (Fanny) are not taken into account. Beatrice and Diana also addressed the issue of Contingent Monetary Value (CMV), which is a valuing procedure to find out the willingness to pay among people or parties (Freeman, 2003). It is worth noticing that some of the issues discussed by the students are also addressed in the

literature and in current research projects (see, for example, Arrow, Dasgupta & Mäler [2004] on resilience, and a new research project on valuing ecosystems services at the Beijer Institute, Stockholm [Beijer Institute homepage]).

In summary, the findings show that all of these students see the benefits of pricing nature in relation to their future profession and environmental concern but, at the same time, all the students perceive different difficulties or insufficiencies in doing that.

Discussion

The results presented here can be considered in relation to students conceiving of economics as 'alien' knowledge, as quoted earlier by Meyer and Land (2006). The students' reactions were of 'anger' and 'disbelief', 'despite students agreeing that such approaches can serve to achieve objectives consistent with their original beliefs (such as wildlife preservation)'. This study can help to clarify what causes this aversion and seemingly contradictory reaction. Pricing is one way of valuing something but, according to these students, a way that excludes aspects of nature, which they find valuable. Also, pricing means surrendering to a system which these students oppose, where economic perspectives and theories are viewed in ideological terms: it is the norms by which much in the world is governed and ruled. This is perhaps where the conceptions of the 'episteme' of a subject clash with personal values and beliefs. This can be regarded as the affective dimension of the students' conceptions, and how it challenges conceptual change. The way values and emotions come into play in the learning process and the way they challenge conceptual understanding has been studied in previous work by Lundholm (2004c; Lundholm & Rickinson, in press). However, when considering the subject of economics, it also entails certain characteristics, as quoted earlier by Davies (2006). Its abstractness, in not pertaining to the individual or company as such, allows for mathematical modelling. Systems thinking is also central, again working as representations enabling modelling and the inclusion/exclusion of different aspects (variables). In that context, nature becomes a variable among many others. However, this depends on what kind of economic theories we are talking about, since there are debates within the subject as well (Davies, 2006). Considering this cognitive dimension in understanding economics is crucial, pointing to the acceptance of abstractness and a systems approach. The statements by the students on the importance of accounting for nature, in several ways, increase the complexity. Indeed, considering both the human and natural world increases complexity greatly.

In discussing the results of the present study, the research by Southerland and Sinatra (2003) on students' understanding of the theory of evolution and 'intentional conceptual change' can also be considered. They write:

> Evolution is a complex topic that is inherently difficult to learn even when one's personal beliefs do not conflict with the content. The situation becomes even more complex when firmly held religious beliefs are perceived to be in direct conflict with the scientific explanations of human evolution in general, and heightened for explanations of human origins. /…/ The learning of ill-defined, complex, or controversial topics that

> conflict with belief systems (such as human evolution) may require that intentional level constructs be evoked if learning and change are to occur. (p.336–337)

If we consider the students' belief systems in the present study, the environment is considered of value to them. From their point of view, economics generally and the pricing of nature specifically might therefore be considered 'a controversial topic'. In the present study, therefore, what might be at stake is the interaction of affect and cognition, a process that is yet to be explored, as described by Southerland and Sinatra (2003):

> We do understand affect to play a mediating role in the conceptual change process, having a recursive relationship with the constructs of epistemology and dispositions, and allowing for inhibiting or the invocation of intentional level constructs and subsequent processing of information. More research is needed however, before we can fully explicate that role. (p.338)

In describing the ways students progress in their understanding of knowledge, Perry (1970/1999) discusses how the term 'commitment' can contribute to our understanding of this cognitive and emotional process. Commitment is a kind of equilibrium, and Perry refers to the work by Piaget, but who did not research young people beyond adolescence. Perry writes:

> The second conceptual contribution is that of Commitment as activity involving stylistic equilibrium. Here the reference extends beyond the content of Commitment to embrace a process in which the person integrates the expressive and the instrumental through affirmations in which his standards are ultimately aesthetic. Because the flowing equilibria that an individual maintains among the stresses of coexistent incompatible states are so personal (e.g., wholeheartedness in the midst of tentativeness), our presentation of the anatomy of the style in Commitment should be a contribution the concept of identity. Furthermore, since what is at issue is the person's manner of experiencing and expressing responsibility, the concept forms a link between the individual and society, a link complementary to, and enlivening of, the concept, of role. (p.234)

Perhaps, what we see in the ways the students experience economics can be understood in relation to the way Perry describes and discusses 'commitment'. However, this means that the students have an awareness of the episteme of economics and biology or ecology, and in the context of that understanding decide, commit, to a way of seeing and explaining the world, in this case to the latter. However, several of the students stressed the need for integration of the domains, on a personal and professional level, thus *seeking* commitment. But, the interviews do not give clear evidence that the students are actually talking about economics in this epistemic sense. Some of the students' experiences seem to be more of an emotional reaction, although they are ethical as well, reflecting their stances and values.

Notes on the Contributor

Cecilia Lundholm was awarded her PhD in September 2003. She is a researcher at Stockholm University, both in the Department of Education, where she is a member of the Conceptual Development research group (www.ped.su.se/rcd) and in the University's Centre for Transdisciplinary Environmental Research. Recently she was appointed theme leader on 'Communication, knowledge and learning' at the newly instated Stockholm Resilience Centre (www.stockholmresilience.su.se), funded by MISTRA. At the centre she will conduct research on communication and learning about nature and natural resources in informal settings, and as part of governance and co-management. Email: cecilia.lundholm@ped.su.se.

Endnotes

1 '*Ecosystems services* are the conditions and processes through which natural ecosystems, and the species that make them up, sustain and fulfil human life. They maintain biodiversity and the production of *ecosystems goods*, such as seafood, forage, timber, biomass, fuels, natural fibre, and many pharmaceuticals, industrial products, and their precursors.' (Daily, 1997:3)

2 Externalities can described as 'negative – when the action of one party imposes costs on another part – or positive – when the action of one party benefits the other party' (Pindyck & Rubinfeld, 1997:658). An example of a negative externality occurs when 'a steel plant dumps its waste in a river that fishermen downstream depend on for their daily catch' (*ibid.*:658).

3 It can be assumed that Beatrice is referring to the term 'existence value', also referred to as 'non-use value'. For a discussion of the term used in the economics literature see Freeman (2003:139–143).

4 'Marginal cost' is the cost for a firm to produce another unit of a specific good.

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