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ANALYSIS

Trends in the development of ecological economics from the late 1980s to the early 2000s

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Abstract

As the contributions to ecological economics are very diverse, recent years have seen some discussion on both how to delimit the field, and in which direction it should develop. The intention with this paper is to contribute to the discussion by outlining important trends in the development of the field from the late 1980s to the early 2000s. The study is inspired by other studies in the sociology and history of science, in particular by the theoretical framework regarding scientific fields as reputational organizations, which draws attention to both cognitive and social aspects of the formation of a field. The basis for the paper is a combination of literature studies, interviews with key researchers in the field, and 'participant observations'. The paper outlines the characteristic cognitive features of ecological economics at the time of the birth of the field. It is then described how the development in ecological economics was influenced by broader social factors during the following years, and how the field was shaped by the inflow and outflow of different groups of researchers. The emergence of different research programmes is outlined, as is the organizational development. Finally, the characteristics of ecological economics are summarized and the future prospects are briefly assessed.

Keywords: History of ecological economics; Research programmes of ecological economics; Sociology of science; History of science

1. Introduction

Since the establishment of the International Society for Ecological Economics in 1988, a wide spectrum of research topics has been presented in its journal and at the conferences. As the contributions are very diverse, recent years have seen some discussion on the characteristics and delimitation of ecological economics: Is ecological economics a transdiscipline; a new paradigm; something different from environmental economics or, rather, a part of environmental economics; open for anything with a relation to the environment; or something more well defined? (Turner, 1999; Spash, 1999; van den Bergh, 2001; Costanza, 2002; Söderbaum, 2000; Martinez-Alier, 2002 ch. 2). The question can also be posed in a more normative way: In which direction should ecological economics be

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developed in the future? The intention of this paper is to contribute to both the positive and the normative discussion by outlining important trends in the development of ecological economics since the formal establishment of the field and by taking a stance concerning the perspective for the future. This paper is a follow-up to a paper on the early history of modern ecological economics (Røpke, 2004), and both papers form parts of a research project concerning ecological economics as a special perspective.[1]

The study is inspired by studies of other scientific fields that historians and sociologists of science have contributed, and Richard Whitley's analytical framework concerning scientific fields as reputational organizations has been particularly helpful. This framework draws attention to both cognitive and social aspects of the formation and character of different scientific fields, so the trends outlined in this paper concern both cognitive and social dimensions, both internal and external factors in relation to the field.

The paper is based on a combination of literature studies, interviews with key researchers in the field, and 'participant observations'. The main written sources comprise Ecological Economics, several conference volumes and other anthologies, as well as monographs and journal articles by researchers who have identified themselves as ecological economists. The interviews have been necessary to give me information that is not available in written form and to provide stimulating perspectives on the issues of the paper. During the period October 2002 until March 2003, I interviewed the following persons: Herman Daly, Mick Common, Robert Costanza, Sylvie Faucheux, Carl Folke, John Gowdy, AnnMari Jansson, Joan Martinez-Alier, Charles Perrings, John Proops, Clive Spash and Peter Söderbaum. Each interview gave me valuable new information, and I have many ideas regarding other persons whom I would like to interview (e.g. to include perspectives from more countries), but time and resources require that a line be drawn. The 'participant observations' arise from my own participation in the field beginning with the Stockholm conference in 1992 and proceeding with all the following ISEE and most of the regional European conferences. Although I have tried to apply a broad perspective to the study of the field, I am well aware that my knowledge of the field is influenced by my background in socio-economics and by my special research interests. Furthermore, it is extraordinary difficult to write a history of something of which you, yourself, are a part, and I imagine that the result is much more controversial than the previous paper on the early history. Obviously, this outline must be seen as supplementary to other accounts based on different perspectives and experience.

Section 2 summarizes briefly the theoretical inspiration from the sociology of science. Section 3 outlines the characteristic cognitive features of ecological economics at the time of the birth of the field; this is a small repetition from my paper on the early history, allowing the two papers to be read independently. In Section 4, it is described how the development in ecological economics was influenced by broader social factors during the following years, and Section 5 highlights the inflow of different groups of researchers to the field as well as the outflow from it. Section 6 outlines the development of different research programmes inside the framework of ecological economics and some of the tensions that have emerged in the field, whereas Section 7 describes the organizational development. Finally, Section 8 summarizes the characteristics of ecological economics related to the theoretical inspiration and briefly assesses the future prospects.

2. Theoretical inspiration

The present structure of scientific disciplines and research fields emerged from a long historical process, where knowledge was fragmented into different disciplines, where research and teaching were institutionalized through the establishment of university departments, and where schools were established in relation to different professions. The traditions and institutions, including the organization of academic training, imply inertia, but the structure is also changing continuously: new fields of research emerge either as new specializations in relation to the established disciplines or as new fields cutting across old borders. In the wake of Kuhn's trailblazing study (1962) of the development of science, other sociologists and historians of science elaborated on his idea

[1] The research project is supported by the Danish Social Science Research Council.

that disciplines develop through different phases (cf. the hypothesis of finalization, Andersen and Knudsen, 1985). However, this idea came under strong attack from the beginning of the 1980s, partly as a result of the increased interest in studying disciplines other than the natural sciences. These studies highlighted that scientific fields differ profoundly from each other in terms of their organizational structures and development patterns, and that they do not develop according to any common phase model. Among the studies of the heterogeneity of scientific fields, Richard Whitley's contribution (2000, 1. ed. 1984) stands out as especially important. His theoretical framework "gathers together, renames, and modifies many of the ingredients" from other sociologists of science (Mäki, 1992 p. 85). Whitley presents his framework integrated with historical observations of the development of different scientific fields, and he develops a taxonomy of fields. In the following, I will concentrate on outlining the dimensions that are important when characterizing a scientific field (drawing on Whitley, 2000; Andersen and Knudsen, 1985; Knudsen, 1994; Wenneberg, 1999; Mäki, 1992, 1993).

Whitley suggests conceiving research as an activity that is analogous to other production activities—research is the production of new knowledge. As other production activities, research is carried out inside an organizational framework with a certain division of labour, coordination and communication systems, and relations to the outside world. The organizational framework is provided by scientific fields that are seen as particular types of work organizations that structure and control the production of knowledge. Coordination and control of the knowledge production are based on the competition among researchers to gain reputations among national and international audiences, and the reputations depend on the extent to which the researcher succeeds in contributing to collective goals related to the development of knowledge in the field. This perspective is intended to apply to scientific fields where researchers have decisive influence on the development of knowledge, the processes of communication, and the access to jobs (excluding research done by industry), so the fields can be seen as relatively self-governing reputational organizations.

Based on inspiration from organization theory, Whitley emphasizes two important dimensions according to which reputational organizations can be characterized: the degree of mutual dependence among the researchers of the field and the degree of task uncertainty. The degree of mutual dependence has two aspects: (1) functional dependence has a technical character and concerns the degree to which a researcher is dependent upon the use of other researchers' results and procedures to construct knowledge claims which are regarded as useful contributions. (2) Strategic dependence has a political character and refers to the extent to which a researcher has to convince colleagues of the importance of the centrality of particular concerns and research strategies to obtain a high reputation among them (Whitley, 2000, p. 88). The degree of task uncertainty also has two aspects: (1) technical task uncertainty refers to the extent to which work techniques produce visible and replicable results that are interpreted in an agreed way (p. 121). (2) Strategic task uncertainty refers to the degree of agreement concerning research priorities and the relevance of research results (p. 123).

Each of the four aspects can vary from "low" to "high", and a scientific field can be characterized by its position on the scale for the four aspects. Whitley bases a typology of reputational systems on the four aspects and exemplifies how different fields can be categorized (ch. 5). Theoretically, sixteen combinations are possible, but some combinations can be ruled out, as they are logically impossible, for instance, it does not make sense to combine low functional dependence with low task uncertainty. Whitley ends up with seven reputational systems that seem likely to be stable. In his exposition of these systems–and throughout the book–he includes a large number of supplementary characteristics of scientific fields, both cognitive and organizational, and he argues that these characteristics can be linked to the degree of mutual dependence and task uncertainty and thus to the different types of reputational system. Furthermore, he identifies different contextual factors that are also associated with the different types of reputational system. By outlining all these relationships, Whitley provides clues to dynamic analyses of the development of scientific fields over time, but the exposition becomes highly complex, and it is not always clear which variables in the 'model' are dependent and independent, respectively (Wenneberg, 1999 p. 227). Instead of trying to summarize the complex relation-

ships, I have chosen to list the different features and contextual factors that are important to consider in a study intended to characterize a scientific field. By listing the aspects this way, no features are given priority as in Whitley's model, so mutual dependence and task uncertainty are included among other characteristics. But the idea of considering scientific fields as reputational systems is still the fundamental perspective, and much inspiration is drawn from Whitley's analyses. I have grouped the features and factors into five categories (other groupings could be used—the most important purpose is to outline the broad array of issues that should be considered):

1. *The knowledge structure of the field and the character of the research work.* Is the basic knowledge of the field well structured and systematically organized? Is it clear what counts as new knowledge? Does it make sense to identify specific research programmes inside the field? Is there a division of labour between subfields? Does theoretical or empirical work dominate the field? Does abstract or specific work dominate? Is the degree of functional dependence high or low? Is the degree of technical and strategic task uncertainty high or low? Does the research require considerable economic and technical resources?
2. *The identity and reputational autonomy of the field.* To what extent can the research be said to have a uniform character? Do the researchers of the field experience a common identity? Does the field have clear boundaries in relation to other fields, and does the field have the power to define its own boundaries? Is it possible to establish an intellectual monopoly, or can researchers from other fields provide relevant contributions? To what extent does the field have control over competence and performance standards in research? To what extent can the field control its own significance standards—the assessment of the relative importance of different research problems and strategies? To what extent do researchers from the field control access to critical resources for research?
3. *The internal organization of the field.* Is the field hierarchic or more flatly structured? Is control over access to resources, communication media, training programmes etc. centred on a few persons? Is the strategic dependence high or low? How fierce is the competition between the scientists? What degree of freedom does the individual researcher have? To what extent is the field internationalized? Does the field have local hierarchies?
4. *The institutionalization of the field.* Has the field established its own professional organizations and journals? Does it command its own communication system? Has a hierarchy of journals been established? Does the field have dedicated departments? Has basic training been organized? Have Ph.D.-programmes been established? Does the field educate professionals for a specific labour market?
5. *Relations to the outside world.* From which sources does the field receive funding? Are the sources diverse? To which audiences do the scientists address their results? How diverse are the audiences? Which kind of outlets does the research have? To what extent can the reputations of the scientists be influenced by audiences outside academia?

These questions emphasize that a field of research is constituted by both cognitive and social factors and that many aspects concur in shaping the characteristics of a field. A scientific field is not only the framework for the peaceful achievement of insight and new knowledge, but also a framework for social processes that can be highly competitive and call for strategic behaviour in struggles for power and influence. Large varieties in the character of different fields are possible. Particularly important to stress is that the social construction of a field of research does not necessarily imply that it is possible to describe precisely the subject of the field. This can apply even to smaller specialties: as Wenneberg (1999, p. 212) notes in his study of the Danish research in systems development (a specialty related to computer science), it is definitely possible to discuss the field with researchers and others in a meaningful way, although the scientific core cannot be defined unambiguously—in this case the field is highly influenced by the declared intent to be transdisciplinary (p. 214).

Obviously, the answers to the different questions above are highly correlated, but it takes a whole book to outline the complex relationships and the inherent

dynamics that arise from changes in different features. For the purpose of this paper the questions are only listed, and some of the causal relationships are dealt with in relation to the analysis of the specific field of ecological economics. In the concluding section, I will summarize the characteristics of ecological economics by answering the questions briefly.

3. The birth of modern ecological economics

Modern ecological economics was institutionalized with the establishment of the ISEE in 1988 and the appearance of the first issue of the journal in 1989. Researchers from several different fields were involved in the formation of the new transdisciplinary field from the beginning, particularly researchers from systems ecology, different strands of economics (biophysical economics, environmental and resource economics, agricultural economics, socio-economics), energy studies mainly based on physics and engineering, and general systems theory (Røpke, 2004).

The initiators shared the basic view that the human economy and the ecological systems are much more intertwined than is usually recognized. Inspired by thermodynamics, systems ecologists had developed a new perspective on the study of ecosystems where processes were described in terms of flows of energy and matter, and through this analysis a group of ecologists became increasingly aware of how the ecosystems were integrated with human activities. Human activities could also be described in terms of flows of energy and matter, and some systems ecologists began to focus much more on economic issues. A related development took place among a small group of economists who were also inspired by thermodynamics. Instead of describing the relationship between the economy and nature in terms of interfaces between two basically different systems (nature provides resources, sink capacity and direct utility for the economy), these economists emphasized that the human economy is embedded in nature, and that the economic processes can also be conceptualized as natural processes in the sense that they can be seen as biological, physical and chemical processes. Therefore, they emphasized that the economy ought to be studied also, but not only, as a natural object, and that economic processes should consequently also be conceptualized in terms usually used to describe processes in nature. In other words, the society could be seen as an 'organism' with a 'social metabolism'. During the 1970s and 80s studies including human activities were still considered outside the realm of mainstream ecology and could be difficult to find publication outlets for ["Ecologists are generally concerned with predicting the impacts of human activity *on* natural ecosystems, but not with understanding and predicting human behavior in the context of natural ecosystems" (Costanza and Daly, 1987)]. The situation in the field of economics was even more complicated as the perspective was virtually non-existent. Whereas the field of ecology was criticized for not dealing with humans as integrated parts of ecological systems, the field of economics was criticized for ignoring the biophysical foundations of the economy. Although economics never had such a strong taboo against dealing with nature in the same way as sociology had (Dunlap, 1997, 2002), the conceptualization of nature was confined by narrow limits.

When economic and ecological systems are conceptualized in the same language of flows of energy and matter, it seems obvious to state that the human economy is embedded in the geo-biosphere of the earth. This is what Herman Daly, using an expression from Schumpeter, calls the preanalytic vision of ecological economics: the human economy is an open system inside the framework of a closed system in the thermodynamic sense (Daly, 1977). The human economy exchanges matter and energy with the larger system of the earth, whereas the earth does not exchange matter with the surrounding universe (except for a few meteors). The earth receives solar energy from outside and emits heat, and this energy flow keeps up the processes of the system. Based on this vision it makes sense to say that the human economy can take up more or less 'space' in the geo-biosphere, or, in other words, that it can appropriate more or less of the biosphere; this 'size' of the human economy is what Daly refers to as the scale of the economy (Daly, 1992). This idea is related to environmental issues, when it is argued that the larger the scale of the economy, the greater the risk of destroying the conditions for human life on earth in the long run. The ecological economic perspective calls for an awareness of the human dependence on well-functioning ecosystems that provide the basic life support

for human societies. This awareness implies that economic growth can be endangering human life in much more subtle ways than the traditional discussion of limits to growth had considered. Accordingly, the first position papers of the field (Costanza, 1989; Costanza et al., 1991) emphasized the seriousness of environmental problems based on the view that nature is the economy's life-support system.

The initiators of the new reputational organisation of ecological economics shared this basic perspective on the embeddedness of the economy in nature, the importance of considering nature as a life-support system, and the need for understanding ecological and economic systems and their interactions in terms of flows of energy and matter. The field was born out of a frustration with the lack of ability of the established disciplines to take in this perspective. In addition to the basic perspective, a number of other related ideas or core beliefs can be said to characterize ecological economics at the time of the establishment of the new reputational organization:

- The idea of the economy's embeddedness in nature and the idea of scale imply that there are limits to the material growth of the economy. It is a core belief that these limits have to be taken seriously and that several *environmental problems are critical*. The economy has already reached or exceeded the maximum sustainable scale.
- *Transdisciplinary work* is essential to meet the challenge of understanding environmental problems and suggesting ways to overcome these problems. None of the established disciplines provides a sufficiently wide perspective.
- *Pluralism* is a key word in the early position papers. This is related to the call for transdisciplinary work, as the reputational organizations of the established disciplines tended to dismiss transdisciplinary contributions.
- Related to the emphasis on nature as a life-support system, there is an awareness of the *basic ignorance* we face in our understanding of nature and of the interactions between humans and their environment. We do not only have to deal with uncertainty, but also with the more basic ignorance that we don't know what we don't know. Important relationships are unknown, so we should be careful with regard to large-scale experiments that might have serious unforeseen consequences. Furthermore, the complexity calls for a 'post-normal science', where multiple perspectives and an extended array of actors are included in the process of providing scientific knowledge (Funtowicz and Ravetz, 1991, 1994).
- *Systems thinking* in a broad sense was shared baggage for several of the initiators, particularly those coming from the natural sciences, but also for some of the economists. Related to systems thinking is a common focus on dynamic and evolutionary processes. The development in systems theory from the late 1960s and early 70s stressing the importance of bifurcations and chaos supported the belief that we face basic ignorance.
- Considering the interests of future generations, the scale of the economy has to be limited, and therefore, the issue of *equity and distribution* comes to the fore. Because of the environmental limits, the poor cannot be cared for by continuing economic growth, so the ethical challenge to take care of other human beings calls for an increased focus on redistribution.
- Many of the initiators were concerned about the deterioration of the environment not only because of the consequences for human beings, but also because of the belief that *nature has value in itself*. Even if we imagine an earth without the human species, it matters whether other parts of nature continue to exist.
- Some of the initiators, particularly those with a social science background, but also some of the natural scientists, emphasized that *the economy is embedded in a broader social and cultural system*, that nature, economy, society and culture co-evolve, that human behaviour cannot be understood only in terms of 'the economic man', so the need for including social and institutional perspectives was emphasized. This view emphasizes the need for transdisciplinarity and pluralism in relation to social sciences other than economics.

At the time of the establishment of ecological economics, these ideas and beliefs were not commonly shared inside the research community—as they still are not, although a wider acceptance has been achieved. As already mentioned, the disciplines of ecology and economics tended to marginalize the

basic perspective of ecological economics, and they were neither transdisciplinary nor pluralistic. Ecologists were typically aware of the seriousness of environmental problems, whereas mainstream economists tended to be far more optimistic and to believe in market mechanisms and technical change to solve any problems that may arise. Furthermore, economic growth was seen as necessary to provide the resources for combating pollution. Economists were generally not interested in cooperation with environmental scientists and criticized them for not being aware of the need to make priorities. Ecologists were seen as a group with the single-minded aim of reducing pollution, whereas economists would always balance this aim against other social aims.[2] Regarding the other ideas, it is worth noting that the awareness of basic ignorance was still not widespread in any discipline. When the European Environment Agency published 'Late lessons from early warnings' in 2001 (Harremoës et al.), the emphasis on basic ignorance could still give rise to headlines and debate. Finally, both mainstream economists and natural scientists tended to consider their own work as value-free, so they preferred to avoid what they considered political issues such as distribution inside the present generation. Based on such important differences it made good sense to establish the new reputational organization of ecological economics.

The ideas and core beliefs of ecological economics can be said to constitute a shared framework of understanding. The framework indicates directions for research, but does not in itself define more specific research programmes. In Section 6, the emerging research programmes are outlined; however, first it is necessary to delve deeper into the social conditions that characterized the period when these research programmes came into being, and to consider the inflow and outflow of researchers in the field.

[2] As Hjorth-Andersen (1975) argued: ecologists' "social goal is one-dimensional: a reduction of the pollution. Economists, on the contrary, take their point of departure in the fact that society has many and costly goals" (p. 144, my translation from Danish). A recent formulation along the same lines can be found in Andersen (2000): "to think in terms of optimality, and to trade off the marginal benefits and costs, simply does not go hand in hand with a natural science background" (p. 108, my translation from Danish).

4. Societal background

The basic ideas of modern ecological economics were formulated in the late 1960s and the beginning of the 70s, coincident with the first wave of public and political interest in environmental issues. During the following years the environmental interest was institutionalized in ministries and departments, new legislation was passed in most industrialized countries; however, the public interest was no longer so intense during the late 1970s and the 1980s (Weale, 1992; Dunlap, 1997). By the end of the 1980s, different analysts had assessed the achievements of the environmental regulation, and they had made the common observation that most countries had experienced a so-called implementation deficit: much legislation had been brought into place and some steps had been taken to solve problems such as acid rain, but the implementation had failed in several fields, and many problems were far from being solved (Weale, 1992). During the 1980s this situation was increasingly seen as unsatisfactory, and politicians began to tighten demands. The first steps were taken towards ecological modernization, as it was called by different theorists (for a brief overview, see Mol and Sonnenfeld, 2000). The classical understanding that environmental concerns and economic growth were conflicting aims was gradually replaced by the understanding that economic growth could be compatible with environmental improvements, a win–win situation. Simultaneously, the global environmental problems came more into focus, for example, the ozone layer, the enhanced greenhouse effect, and the threats to biodiversity. The need for international cooperation became obvious. In 1987 the Brundtland Report was published and spurred the widespread popularity of the sustainability concept and the idea that the needs of present generations should be fulfilled without jeopardizing the possibilities of fulfilling the needs of future generations—aims to be confirmed at the Rio conference in 1992. The establishment of ISEE in 1988 thus coincided with a breakthrough in the public and political interest in environmental issues, constituting what could be called a second wave of environmentalism (Dunlap, 1997).

The establishment of ISEE was not a result of this second wave of general interest in environmental

issues—the roots went back to the 1960s, and the establishment followed a long gestation period (Røpke, 2004). But the fact that the establishment coincided with this second wave gave the initiative a flying start. The period was characterized by a popular breakthrough for some of the ideas that were central to ecological economics, for instance, that pollution can be an even more important limiting factor than resources (the focus of the old limits to growth debate). Although *The Limits to Growth* book (Meadows et al., 1972) included a broad variety of aspects such as population growth, scale and pollution problems, the critics of the book tended to focus mainly on the resource constraints, so much of the debate became more narrow than the book deserved, because basic life-support systems can be threatened—as illustrated by the case of the ozone layer. Also, the sustainability concept and related concepts (e.g. Daly's steady state), which were not really new, became popularized in the wake of the Brundtland Report (see e.g. Pearce, 1987). The interaction between popular interest and intensive media coverage generated an inflow of new students to environment-related education and an inflow of researchers to different areas of environmental research. The early 1990s saw the establishment of the European Association for Environmental and Resource Economics (first conference in 1990), a new wave of interest in environmental sociology (Dunlap, 1997, 2002), the emergence of industrial ecology (Erkman, 1997), increasing interest in political ecology and human ecology etc. When ISEE held its first conference in Washington in 1990, over 370 participants attended (Costanza, 1991 p. xi). Twice as many people showed up as were pre-registered—some people in Washington just came in off the street (Costanza, personal communication). The second conference in Stockholm in 1992 also drew people, with more than 450 participants (Jansson et al., 1994 p. xv), several of whom had taken a relatively recent interest in the environment (including myself).

The public and political interest in the environment during most of the 1990s improved the access to funds for transdisciplinary research on environmental issues. In the United States some of the large foundations, for example, the Pew Foundation and the Ford Foundation, were important contributors to ecologic economic research and the establishment of the University of Maryland Institute for Ecological Economics. In Sweden, the Wallenberg Foundation had already supported one of the workshops that led to the establishment of ISEE, and the foundation later funded both a workshop in relation to the Stockholm conference in 1992 and the establishment of the Beijer Institute (more on this in the next section). In Sweden and other European countries, public funding was decisive for the strengthening of research on environmental issues—funding which was increasingly channelled through dedicated programmes. Thus the encouragement of environmental research became part of the general trend towards more government influence on the direction of research, as well as part of the trend towards having more research placed in institutions outside the universities (Gibbons et al., 1994; Whitley, 2000). Although the dedicated programmes and the related reviewing processes tended to be highly influenced by discipline-oriented researchers, the declared intention in some programmes of promoting transdisciplinary research opened new possibilities for less traditional researchers. The conditions for establishing the new field of ecological economics were thus beneficial, and the initiators were not slow to take advantage of the new focus on sustainability, as the title of the first conference volume demonstrated: *Ecological Economics. The Science and Management of Sustainability* (Costanza, 1991).

However, by the late 1990s the tide began to turn again. The public interest in environmental issues was met with a backlash, supported by conservative think tanks (see e.g. McCright and Dunlap, 2003), and other concerns related to immigration and terrorism became dominant in western countries. Although the work with environmental issues continues to have momentum, it has become more of an uphill climb in recent years.

5. Inflow and outflow of researchers

When ecological economics was institutionalized, some basic ideas could be said to characterize the field, as described in Section 3. However, the development of more specific research programmes in the field was highly influenced by the inflow and outflow of researchers during the following years. I

have identified four important trends that were decisive for the development of the field.

5.1. The attraction of socio-economists

Firstly, the field tended to attract different kinds of socio-economists with a background in institutional, evolutionary and Marxian economics, political economy, economic sociology, economics of innovation etc. Neoclassical economists interested in the environment already had the chance to organize in AERE (Association of Environmental and Resource Economists) and EAERE. These organizations had frequent conferences and related journals, and as mentioned, only few neoclassical economists at the time were really interested in transdisciplinary work. For socio-economists the situation was different, particularly in Europe. In several socio-economic organizations environmental issues surfaced in the beginning of the 1990s, but they tended to disappear again or to be given low priority. For instance, the European Association for Evolutionary and Political Economy (EAEPE) held a conference in Barcelona in 1993 highlighting the topic of growth and the environment (based, partly, on contributions from some of the persons who were also active in ecological economics, Joan Martinez-Alier, Jan van der Straaten and Peter Söderbaum), but the issue then died out again. A research group on the environment was re-established in EAEPE, but the conferences did not, and still do not, reflect much activity in this field. In the Society for the Advancement of Socio-Economics (SASE) environmental issues were relatively visible in the beginning of the 1990s, not least because of Beat Burgenmeier's efforts, but also here the environment was overtaken by other issues—the present list of research groups in SASE does not mention the environment. The Association for Social Economics (ASE) has been, and still is, a meeting place for environmentally interested socio-economists, mostly American, but also a few Europeans. Georgescu-Roegen was involved in this association and he published in their journal, *Review of Social Economy*. This journal was, and is, an outlet for papers on the environment, and the meetings had sessions on the environment, although the main issues were income distribution, critique of neoclassical economics etc. (however, the call for papers for the 2004 World Congress does not mention the environment). Another mainly American based association, the Association For Evolutionary Economics (AFEE), which publishes the *Journal of Economic Issues*, has also taken some interest in the environment. The association organizes the heirs of American institutional economics, and part of this group are real technological utopians who think that technology will solve all problems, whereas the other part share the basic ideas of ecological economics, for instance represented by Jim Swaney (Gowdy, personal communication). Some Europeans (e.g. Peter Söderbaum) found their way to the mainly American based associations; here, the environment could be discussed; however, with the establishment of ecological economics, this field became an obvious choice for European socio-economists with an environmental interest. This tended to create a self-fuelling process, as the socio-economists did not then spend much time in strengthening the position of environmental issues in the socio-economic associations, such as EAEPE, which, as a result, did not become more attractive for environmentally interested researchers, and so on.

In the beginning of the 1990s, a peculiar occasion brought together some of the socio-economists who became active in ecological economics. Two Romanians, the Milan gas-tycoon J.C. Dragan and M.C. Demetrescu, an academic in management, wanted to see their compatriot, N. Georgescu-Roegen, get the Nobel Prize in economics (Dragan and Demetrescu, 1991). To support this claim they wanted to initiate an Association for Bioeconomics and asked some of the admirers of Georgescu's theories to help them in this venture—Joan Martinez-Alier and Eberhard Seifert. The association held its first conference in 1991, in Dragan's palace in Rome. Martinez-Alier and Seifert used such patronage to gather people interested in Georgescu's work, and several of these people, who were or became ecological economists met there for the first time, for example, John Gowdy, Kozo Mayumi, Kanchan Chopra, Fritz Hinterberger, Martin O'Connor (and myself). Herman Daly was invited, but did not come, as he had some doubts about the quality of the work that Dragan and Demetrescu were doing. The small conference was highly interesting, but the association was unusual with a self-appointed board. A later conference followed at Dragan's summer residence

on Mallorca. The death of Georgescu put an end to the initiative, and the efforts of several of the people involved were then concentrated in ISEE (papers from the conferences are published in Martinez-Alier and Seifert, 1993; Dragan et al., 1997).

The socio-economists who were attracted to ecological economics had an obvious interest in strengthening the socio-economic perspectives inside the society, maintaining the idea that the economy is embedded in society and culture and that this should influence the analysis of environmental issues. With the intention of promoting the socio-economic agenda, a workshop was organized at the Wuppertal Institute in 1995 (by a group composed of Fritz Hinterberger, Jan van der Straaten, Michael Jacobs, Joan Martinez-Alier, and myself), resulting in a call for socio-ecological economics in the ISEE newsletter (Jacobs, 1996). When the European Society for Ecological Economics was established shortly afterwards (inaugural conference in 1996), the socio-economic influence was relatively strong.

5.2. The attraction of mainstream economists

The socio-economists were not the only group to be attracted. The second trend was the attraction of mainstream environmental and resource economists, particularly in the latter half of the 1990s. The mainstream economists were there from the beginning, first of all David Pearce, who had written papers that were unusual for environmental economists (Common and Pearce, 1973; Pearce, 1987), but he more or less withdrew when he became absorbed in the establishment of the Blueprint-projects in Britain (Pearce et al., 1989). The mainstream economists were not central to the running of the society during most of the 1990s, arranging the conferences etc. (except for the few who served as referees for the journal); however, they became increasingly visible in the journal, especially when the number of issues was increased from 1994. This is a consequence of the obvious fact that the number of mainstream economists is much larger than the number of economists from heterodox traditions. Furthermore, the 1990s witnessed an increasing pressure to publish internationally: while 'publish or perish' had been well known at American universities for some time, also for the social sciences, the publication pressure had a tremendous effect in Europe, and environmental economists were, too, looking for publication outlets, particularly journals where a paper would be accepted with relative ease. As *Ecological Economics* proved to be a successful journal, it was an obvious choice, as it was difficult to get into the hard-core economics journals. Paradoxically, the mainstream economists were also quite numerous at the ESEE inaugural conference that was arranged by researchers with a more socio-economic orientation. This, however, did not prevent David Pearce from coming under heavy fire from the audience when he suggested that ecological economics was just a part of environmental economics.

The establishment of the Beijer Institute also became an important factor in attracting mainstream economists to ecological economics, so the story will be summarized briefly (based on drafts for the ten-year Anniversary book and AM. and B.-O. Jansson, personal communication). In 1974 the Swedish financier Kjell Beijer announced to the secretary of The Royal Swedish Academy of Sciences (a self-elective body of academics) that he was willing to make a substantial donation to the environmental cause. This resulted in the formation of the first Beijer Institute, The International Institute for Energy, Resources and the Human Environment, which grew successfully and created branches in different countries. When in 1988, in the wake of the Brundtland Report, the Swedish government wanted to strengthen its environmental efforts, the state-owned Stockholm Environment Institute was founded, and this institute simply took over the personnel and tasks from the Beijer Institute. The Beijer Foundation was willing to sponsor a second institute, if the Academy could suggest a new, suitable purpose. One of several suggestions came from the academy members Bengt-Owe Jansson and Karl-Göran Mäler (in cooperation with AnnMari Jansson and Karl-Erik Eriksson) and had the provisional title 'Integration of Ecological and Economic Systems'. The proposal emphasized the seriousness of global environmental problems and the need to analyse the factors causing them—the economic and social processes of our society. To meet the challenge of creating the

basis for a more sustainable system, including a fair distribution between generations and countries, a transdisciplinary systems approach was suggested as being absolutely necessary. In 1990 it was decided to support this proposal and to establish the second Beijer Institute with the name The Beijer International Institute for Ecological Economics.

Among the members of the first board were Partha Dasgupta, Herman Daly, Paul Ehrlich, Buzz Holling, David Pearce, Thomas Zylicz, and the two proposers, with Mäler as the Director of the Institute. The first two research programmes were headed by Charles Perrings (the economy of biodiversity) and Bob Costanza (the interaction between complex ecological and economic systems). In 1991 Carl Folke became deputy director of the institute. Bengt-Owe Jansson had suggested including Daly on the board, as he was very impressed by Daly's approach and wanted him to influence the development of the institute. However, among mainstream environmental and resource economists like Dasgupta and Mäler, Daly was an outsider, and historically he had sided against Dasgupta and Mäler in the 1970's debate on the limits to growth. Dasgupta chaired the board, and some of his decisions made Daly so angry that he "got disgusted with the whole thing" and finally decided to resign (Daly, Personal communication). Looking back, there was some inconsistency in B-O. Jansson's aims: on the one hand, he wanted to promote cooperation with powerful mainstream economists, as the environmentalist cause could be strengthened enormously by support from such influential persons (cf. the concluding section in Røpke, 2004), and on the other hand, he would like to see Daly's perspective influence the work, and, in several respects, Daly's ideas are basically at odds with mainstream neoclassical thinking. As the combination did not succeed, the Beijer Institute concentrated on cooperation between ecologists and mainstream economists, and the transdisciplinary work had a strong emphasis on modelling the interrelationships between ecological and economic systems. This cooperation was and is facilitated by the common language of modelling and common understandings regarding scientific methods and criteria for what counts as scientific work.

The transdisciplinary cooperation between ecologists and mainstream economists was also facilitated by the changes that occurred in environmental economics during the 1990s. Whereas the dominant topics from the mid-1970s and throughout the 1980s had been valuation and economic instruments, the Brundtland Report sparked an interest in the sustainability concept and a revival of some earlier contributions that could be useful in the new debate (e.g. Ciriacy-Wantrup's 'safe minimum standard' approach (1952); see Pearce, 2002 on the changes in environmental economics). The discussions that were the background of ecological economics came to be reflected in the development of environmental economics; therefore, some considered ecological economics to be a special branch of environmental economics—the branch dealing with the relations between the economy and the ecosystems and with a focus on the life-support systems. This way of seeing things became all the more tempting, as ecological economics turned out to be a success: the membership rose quickly, the conferences had many participants, and the journal had many subscribers (see Section 7). As the field appealed to a much broader group than environmental economics, the following was higher. As the concept of ecological economics became successful, it became an interesting concept to appropriate and define—just as the concept of sustainability, on a much larger scale, became a subject of controversy. It is worthwhile capturing the ownership of such a concept, as the definition impacts on real politics and on power in academia. This was Daly's worry in relation to the dominance of mainstream economists at the Beijer Institute: "I felt it was a kind of take-over—here is something called ecological economics, it is beginning to get a little following, it might get in the way some day, let's just take it over".

5.3. Developments in ecology

The third trend concerns the development inside the discipline of ecology. When ecological economics was established, it was still unusual for ecologists to deal with human activities as integrated parts of the ecosystems. The journals of mainstream ecology, such as *Ecological Applications*, were not open to papers on the interplay between humans and nature, so researchers with these interests had a need for the new reputational organization of ecological economics.

However, this situation changed completely during the 1990s, and Carl Folke emphasizes that the change was partly due to efforts related to ecological economics (personal communication). Among others, the Beijer Institute has been instrumental in bringing new perspectives into mainstream ecology by involving key mainstream ecologists, such as Simon Levin, Brian Walker, and Steve Carpenter in steering groups and projects. In a book review on ecology, Charles Hall (1994) notes that the development inside the field has become increasingly splintered, and both Costanza and Folke argue that the traditional distinctions between population ecology and systems ecology tend to have become eroded. The field has thus become much more open to transdisciplinary contributions, so ecologists with broader interests do not have to orient themselves towards other reputational organizations to publish. As examples, Folke refers to a special issue of Ecological Applications (2000) on traditional ecological knowledge, ecosystem science, and environmental management and to a paper on social taboos (Colding and Folke, 2001) that would have been unthinkable to publish ten years earlier. This trend implies that ecologists do not have the same motivation to take part in ecological economics as they had in the beginning.

5.4. More competition

The fourth and maybe most important trend is the development of a large number of 'competing' fields. The term 'competing' refers to researchers having limited time and resources to go to conferences, read journals and take part in the practical and political work related to reputational organizations. Ecological economics was among the first transdisciplinary fields that had a take-off in relation to the second wave of environmental interest, but many other fields developed their own reputational organizations more or less simultaneously. An obvious example is the field of common property that could, in principle, have been an important part of ecological economics: The International Association for the Study of Common Property was established in 1989 and had its first meeting in 1990. This organization attracted a number of persons who otherwise would have given priority to ecological economics. Another example is the field of business studies related to the environment, which has been institutionalized in the Greening of Industry Network and later also in the International Society for Industrial Ecology. There are important overlaps between ecological economics and industrial ecology, as both fields cover studies on social metabolism–material and energy flows in the economy–but the composition of followers differs, as engineering and management are more prominent in industrial ecology. Another field that overlaps with ecological economics is the study of ecosystem health, which was institutionalized in the International Society for Ecosystem Health in 1994. The main organizer was David Rapport, who plays a role in ISEE too; Bob Costanza was also among the founders. The founders came from the fields of medicine, veterinary medicine, ecology, and economics, and their intention was "to explore potential transfers from the fields of human and veterinary medicine into ecology" and to understand "the critical links between human activity, ecological change, and human health" (Rapport et al., 1999). Several other examples of competing fields could be mentioned, most of them more narrowly defined than ecological economics. Seen from the perspective of ecological economics, the existence of these organizations implies that the specific fields have a relatively limited place inside ecological economics.

The substantial growth in research related to environmental issues also implied that conferences on empirical topics, such as marine ecosystems, fisheries, biodiversity etc. could attract a sufficiently large number of participants, and these conferences increasingly included transdisciplinary perspectives. The empirically focussed conferences can be more useful in relation to one's own research; as AnnMari Jansson says: "When I go to a conference on marine ecosystems, I understand nearly everything—that is not the case at an ecological economics conference". The growth of these conferences also tended to dilute ecological economics.

These trends constitute a part of the framework for the development of research programmes inside ecological economics, which is explored in the next section. Other important trends related to inflow and outflow of researchers concern the geographical diffusion of ecological economics, which is dealt with in Section 7.

6. Research programmes of ecological economics

It is a difficult, if not impossible task to identify the main topics and research programmes of ecological economics. Based on the journal and the conferences the field could be said to cover almost anything with a faint relation to the environment. It would probably be possible to find a representation of most of the areas covered by the Handbook of Environmental and Resource Economics (van den Bergh, 1999), the Handbook of Ecosystem Theories and Management (Jørgensen and Müller, 2000), A Handbook of Industrial Ecology (Ayres and Ayres, 2002) and the International Handbook of Environmental Sociology (Redclift and Woodgate, 1997), and still the list would not be exhaustive. However, some issues are more central to the field than others, for instance, I find that an issue directly related to the core beliefs, such as the scale issue, is generic to the field, and it is also hard to imagine something called economics without a debate on economic value. Besides scale and value, other topics too were inherited from the research leading to the formal establishment of ecological economics, for instance, several energy-related issues and discussions on the key works that inspired the field. Later, different research topics emerged in relation to the field—for example the ecological footprint concept, which is much discussed in Ecological Economics, but appears neither in the Journal of Environmental Economics and Management, nor in Environmental and Resource Economics (according to search in article databases, August 2002). In the following I will try to outline briefly some of the central topics and programmes—well aware that the selection must be based on a personal assessment of relative importance. Firstly, I introduce the processes of identity formation encouraged by the formal establishment of the field, secondly the scale issue including the resilience perspective, thirdly valuation and decision-making, and finally some of the tensions that emerge in relation to the research programmes.

6.1. Processes of identity formation

When the reputational organization of ecological economics was established, it was far from obvious how the field was to be defined. Consequently, the following years witnessed what could be called 'identity work' or processes of identity formation. At the personal level, identity is formed by considering, on the one hand, the similarities between oneself and others and, on the other hand, how one differs from others; related processes can apply to organizations. In the first anthology (Costanza, 1991), such an exercise is done in the introductory chapter by comparing ecological economics with "conventional" economics and "conventional" ecology, illustrating some general characteristics of ecological economics, for example the dynamic systems view and the co-evolutionary perspective. 'Identity work' includes the exploration of the roots of field (the similarities with others in the past), and this was already well under way with the publications of Martinez-Alier (1990, first published 1987), Cleveland (1987) and Christensen (1987), later followed by, e.g., Christensen (2001). The roots are not only considered in order to find similarities, but also to provide starting points for research questions. One of the key modern roots of ecological economics, Georgescu-Roegen's book on *The Entropy Law and the Economic Process* (1971), became the focal point for a long controversy after the establishment of the field: Can the entropy law be applied in the way Georgescu does? Does it make sense to introduce a fourth law regarding the degradation of matter as Georgescu suggests? (see e.g. Khalil, 1990; Lozada, 1995; Ecological Economics, 1997). A study by Gowdy (1991) on bioeconomics and post Keynesian economics can also be seen in the light of searching for similarities.

Concerning the differences in relation to others, the main focus became the relationship with mainstream economics. As far as I have been able to identify, the relationship with ecology did not generate direct controversies that were reflected in *Ecological Economics*. Rather, the work on ecology in relation to ecological economics–focusing on integrating human activities and ecosystems—gradually influenced mainstream ecology, as described in the previous section. As mentioned in Section 3, the core ideas and beliefs of ecological economics were not commonly shared inside the research community at the time of its establishment, and the dividing lines in relation to mainstream economics generated much

ecological economic research in the 1990s. I use here the expression mainstream economics instead of environmental economics (short for environmental and resource economics) on purpose, because some of the controversies were rooted in more general questions than those dealt with by environmental economics. When the basic ideas of ecological economics are confronted with the dominant dogmas of mainstream economics, the following controversial issues emerge:

- The question of substitution between natural and man-made capital. To what extent is it possible to replace natural capital with man-made capital? To what extent are the two types of capital complementary (e.g. Daly, 1990)?
- The question of growth and the environment. Does economic growth lead to improvement or deterioration of the environment? In relation to the question of growth, it was particularly important for ecological economics to bring home the message of nature's basic life-support functions, the importance of the cycles in water, nitrogen etc. (e.g. Ayres, 1993).
- The question of trade and the environment. Does an increase in international trade lead to improvement or deterioration of the environment (e.g. Ecological Economics, 1994)?
- The question of technological change. To what extent can technological changes solve environmental problems? How should technological change be guided in an environmentally benign direction (e.g. Faucheux and Nicolaï, 1998)?
- The question of quality of life. Does quality of life increase with economic growth? Is it possible to develop measures that reflect changes in welfare better than the GDP measure?
- The question of the view of nature. Does nature have intrinsic value? Should nature be protected also for its own sake or only because of human interests?

In several cases, controversies were sparked by publications from international organizations such as GATT/WTO, OECD, or the World Bank that advanced traditional views and thus called for the critical perspectives of ecological economics. A special example was the proposition of the Environmental Kuznets Curve that generated an extensive critical debate, largely concentrated in Ecological Economics (Ecological Economics, 1998a,b, 25:2).[3]

Sometimes, issues such as those listed above are used to contrast ecological economics with environmental economics (e.g. van den Bergh, 2001). The answers to the questions clearly tend to differ between environmental and ecological economics: ecological economists are more sceptical towards the possibilities for substitution, more critical towards the positive impacts of growth and trade, have less trust in the positive potential of technological change, are sceptical towards the idea that quality of life improves with economic growth in the rich countries, and more readily accept that nature has intrinsic value. However, the answers are not static—the positions have changed during the last 10–15 years, as more environmental economists now share some of the concerns of ecological economists, as already mentioned in Section 5.

6.2. The scale issue and the resilience approach

Another central activity of ecological economists was to elaborate on the core ideas and beliefs—beyond the research generated in relation to the controversies mentioned above. The most basic idea concerns the embeddedness of the economy in nature and the related idea that the human economy can be said to take up more or less 'space' in relation to the closed system of the earth. The larger the scale of the economy becomes, the greater the risk of destroying the conditions for human life on earth in the long run. Different research programmes deal with the scale issue in different ways, as illustrated below by brief summaries of the approaches to 'calculate in nature' followed by the ecological approach.

Based on the scale idea it becomes an important issue for research to operationalize the scale of the economy: How can we assess the present scale of the human economy at a global level? Can we express an opinion on the present direction of the development?

[3] The large number of papers on the Environmental Kuznets Curve also illustrates the interesting phenomenon that an idea can be particularly suitable for paper-writing, when the possibilities for testing are endless—important in these days with a strong pressure for publishing (a point suggested to me by Glenn-Marie Lange).

Is it possible to establish which scale would be sustainable? Ecological economics has generated much research on different approaches to these questions, particularly on the economy's direct and indirect appropriation of energy, exergy, land area, the product of photosynthesis, and materials. Obviously, the research was drawing on previous results (energy studies, in particular, were well developed; briefly covered in Røpke, 2004), but ecological economics provided a take-off for different approaches to 'calculating in nature' (see overview in Martinez-Alier et al., 2001). The Wuppertal Institute was instrumental in bringing new life to materials flow analysis (MFA) by introducing the rucksack concept and the MIPS concept (Material Input Per unit of Service; Schmidt-Bleek, 1994; Hinterberger et al., 1997) and initiating the work resulting in the report *The Weight of Nations* (Matthews et al., 2000). MFA was taken up by different European statistical offices, and a strong research group on 'social metabolism', headed by Marina Fischer-Kowalski, was established at the Institute for Interdisciplinary Studies of Austrian Universities (the intellectual history of materials flow analysis from 1970 to 1998 is outlined in Fischer-Kowalski and Hüttler, 1999). The idea of ecological footprints was first launched by Rees and Wackernagel (1994, elaborated in Wackernagel and Rees, 1996) and has been followed by many other contributions (Ecological Economics, 2000). Both MFA, rucksacks and the footprint idea have generated very fruitful controversies inside ecological economics, deepening the discussions on how to conceptualize scale and the state of the environment. The initial calculations of human appropriation of photosynthesis were made by Vitousek et al. (1986). This idea has generated less research in the ecological economics community, but interesting follow-up calculations have been made (Vitousek et al., 1997; Haberl, 1997; Rojstaczer et al., 2001; discussed by Haberl et al., 2002).

The different 'calculations in nature' are not only applied on a macro level. For instance, regional calculations have been made, and the methods open up new possibilities for conceptualizing inequalities and unequal exchange between nations (for a recent contribution see Giljum and Eisenmenger, 2004). For instance, the following questions are discussed: What are the relations between income and appropriation of energy, land area and materials? Does the seemingly equal exchange in monetary terms co-exist with unequal exchange in terms of energy, materials or the use of land. Does it make sense to say that the rich acquire their high living standards at the expense of the poor? Furthermore, these perspectives offer a critical potential in relation to such concepts as the genuine savings idea: if a country succeeds in having positive genuine savings, the reason might be that the country has succeeded in appropriating resources from others, and it then seems highly dubious to call that sustainability.

The different 'calculations in nature' apply concepts from the natural sciences and try to describe social processes of production and consumption in natural science terms. However, the focal point of these studies is the society and not the different ecosystems of which humans are a part. For ecologists this approach can seem limiting, and Carl Folke argues that it has been too dominant in ecological economics (personal communication). There is a strong need to also apply approaches that take their point of departure in ecosystems and deal with the relations to human activities from the perspective of the ecosystem. An example of such an approach centres on the resilience concept, and it can be seen as a way of dealing with the scale issue from an ecological perspective (the following outline draws heavily on Perrings, 1997; Levin et al., 1998; Folke, 1999). I elaborate on this perspective, which is central, for example to the work of the Beijer Institute, because it is important for the discussion of tensions in the last part of this section.

The focus of this perspective concerns the risks related to the disturbance of ecosystems, when the human economy grows greatly in relation to its environment. The basis of the research programme is systems thinking: both ecological and economic systems are seen as complex, self-organizing, living systems. Furthermore, because of the scale of the economy, the present era is seen as characterized by an unprecedented integration of ecological and economic systems, so they should be studied as co-evolving systems; in other words, jointly determined ecological-economic systems. The theoretical basis of such studies is inspired by work on far-from-equilibrium systems in modern thermodynamics and the mathematics concerning non-linear dynamical

systems—tools that were applied in ecology from the beginning of the 1970s. Ecological, and later ecological-economic, systems are seen as hierarchies (such as food-webs), where small fast-moving systems are embedded in and constrained by large slow-moving ones, and where the dynamics at one level emerge from phenomena occurring at lower levels of the overall system. The systems are linked in time and space, and their development is path dependent, so changes might be irreversible. As the systems are characterized by non-linear feedbacks, small disturbances can become magnified and lead to qualitatively new and unexpected behaviours at more macroscopic levels. In general, ecological–economic systems have multiple locally stable states (or multiple equilibria) with different properties, and a system can flip from one state to another when a threshold is crossed. The development of a system can thus be discontinuous and characterized by punctuated equilibria. There are numerous examples of discontinuous ecological change as a result of a gradual build-up of economic pressure, for instance, grazing pressure beyond a critical threshold can lead to desertification. Sometimes the connections are very indirect, for instance, when Canadian boreal forests are threatened by budworm outbreaks because of the destruction of habitats of certain bird species in Central America (Perrings, 1997 p. 237 on the findings of Holling and cooperators).

As fundamental changes in ecological–economic systems can involve a loss of function and productivity seen from a human perspective, a central research question concerns the ability of systems to absorb stress or shock without losing their self-organization. This ability is called the resilience of the system (in the sense of Holling, 1973, 1986), and in principle, it can be measured by the severity of shock that can be absorbed before the system flips to another stability domain. One of the most important factors influencing the resilience of a system is the diversity of organisms constituting the system. For given environmental conditions, some keystone species are crucial in maintaining the organization of the system; however, if these conditions change, the non-keystone species may become important to buffer disturbances and eventually to take over the mediating role of the former keystone species. Therefore, biodiversity can be said to constitute a kind of life insurance.

From a human perspective the functioning of ecosystems is decisive not only because of the provision of natural resources and the capacity for assimilation of pollution, but even more so because they provide a variety of ecological services, including life-support services, which humanity cannot do without. Examples are the maintenance of the composition of the atmosphere, amelioration of climate, operation of the hydrological cycle, recycling of nutrients, generation of soils, and pollination of crops. Therefore, the protection of the resilience of critical ecosystems must be an important element in any sustainability strategy. Unfortunately, the increasing scale of economic activity endangers the resilience of important systems and, in addition, the scale-induced increase in interconnectedness and complexity of ecological and economic systems implies that the future evolution of ecosystems has become even more unpredictable than before. The approach thus justifies the precautionary principle and calls for more research into the functioning of ecological–economic systems, including both macro-oriented operationalizations and micro-oriented studies of more restricted systems—the field of management of ecosystems.

In several important respects this research programme differs from mainstream research in environmental and resource economics:

- The concept of sustainability is basically different. As Common and Perrings (1992) formulate it, ‘Solow’ or economic sustainability and ‘Holling’ or ecological sustainability are largely disjoint.
- “Neither joint system dynamics nor threshold effects have been adequately addressed by existing economic or ecological theory”, probably because both disciplines have “developed a strong focus on the equilibrium properties of the systems under study” (Perrings, 1997 p. 232–3). Generally, environmental and resource economics tend to focus on efficiency, and ignore ecosystem dynamics and scale issues (Costanza et al., 1997b, Introduction).
- “Natural resource economics has mainly analysed a single resource population in isolation from the ecosystem of which the population is a part” (Folke, 1999 p. 906). However, as ecosystems are multifunctional, it is possible to disrupt a wide

range of economically important ecological services by depleting one population.
- Market prices do not indicate whether a system is approaching the limits of system resilience. In general, the state of an ecological–economic system is neither observable, nor controllable through prices as mainstream economics tends to suggest.
- Policy should be concerned with more than the immediate consequences of incremental actions, as the potential for an accumulation of small actions to destabilize important systems should be recognized.

Despite these differences, the proponents of this research programme tend to be very cautious in their critique of mainstream research. Instead, they emphasize that mainstream research is moving in the same direction, for example Perrings notes that economists have recently become more interested in the dynamics of complex non-linear systems, in particular in relation to problems in finance.

Surprisingly, not much of the research related to this research programme has been published in Ecological Economics. Reflecting the prominence of ecology among the roots of the field, the journal includes a large number of papers on management of natural resources (forests, land use, marine resources, water issues), but many of these apply a relatively traditional perspective on a specific resource.

6.3. Valuation and decision-making

Including 'economics' in the name of the field implies that values must be a core issue. As Gowdy and Erickson (in press) write: "Value" is the essence of economics. The history of economic thought is largely one of competing concepts of value". In particular, valuation became an important topic for the socio-economists who were attracted to ecological economics. Others also dealt with valuation, including the researchers related to the ecosystem programme outlined above, and I will return to the different approaches after a brief presentation of the socio-economic work (this presentation is also included to provide a background for a comparison with the basic thought patterns of the resilience approach).

Socio-economic approaches were apparent in ecological economics from the beginning, represented by, for instance, Martinez-Alier, Norgaard (see e.g. Norgaard, 1994), and Söderbaum. Very briefly, the basic perspective of socio-economic, institutional, evolutionary approaches can be summarized in a few statements (based on Spash and Villena, 1998 and my own previous work, Røpke, 1998, which includes references to Hodgson, Lawson, and Kapp):

- The analyses focus mainly on the level of social structures and institutions. The concept of social structures relies on the fundamental idea that a whole (or a system) is more than the sum of its parts. Social patterns and structures as well as cultural understandings emerge as a kind of spontaneous order when social actors carry out specific social practices, and the structures exist only by way of the repeated social practices. When a pattern develops, it is usually accompanied by the building up of related physical structures as well as formalized institutional arrangements: organizations, contracts, entitlements, laws, and regulations that help "freeze" the patterns. When a pattern has emerged, new conditions and limits are imposed on the parts of the whole, so social actions are moulded by the patterns (elaborated with more focus on change in Røpke, 1998).
- The motivations and behaviour of human beings are moulded by social structures, institutional arrangements, cultural norms, and ethics. Preferences are endogenous to social change, and motivations are much broader than considerations concerning individual consequences.
- Social processes of change are evolutionary and dynamic, based on cumulative causation (using the expression of Myrdal and later Kapp) and path dependency. As part of these processes, technological changes are endogenously shaped.
- Social change is characterized by conflict rather than harmony, so the existence of power and privilege is at the centre of interest. Markets reflect the predominant power relationships and existing institutional arrangements, and both monetary and non-monetary costs and benefits are contingent on these arrangements. There is no single efficient policy choice but rather one for every possible

institutional arrangement (Spash and Villena, 1998 cite Bromley on this, p. 9).
- Therefore, "prices are not worth much" (Røpke, 1999), when it comes to the assessment of values. Basically, values are incommensurable, both in economic terms and in terms of, for example energy.[4] Some entities may be measurable and non-comparable; some may by comparable and not measurable, while others may be neither measurable nor comparable (Spash and Carter, 2001 p. 9).
- It makes sense to distinguish between social values and individual values. As Swaney (1987) puts it, society is organic and has needs that are different from the sum of needs or wants of individuals, one of the reasons being that society has a much longer life expectancy than individuals.
- Theories and analyses will always be influenced by values, so politics and economics are combined and inseparable. Therefore, values and ideology should be discussed openly, and awareness of implicit value judgements in research be promoted (Söderbaum reminds us of this point by quoting Myrdal, e.g. in Söderbaum, 1992).
- Analyses should include rich empirical descriptions and avoid a high level of abstraction as guidance for policies (avoiding the fallacy of misplaced concreteness). This is in line with old institutionalism and tends to repudiate at least some of the so-called new institutionalism.

This outline has been formulated without referring directly to environmental issues, as the ideas were developed inside a social science framework. Kapp (1910–1976) was an exception with his very early application of an institutional perspective to environmental issues, including the points on pervasive and systemic externalities, basic uncertainty and interdependencies of environmental and social systems—ideas basically in accordance with the foundational ideas of ecological economics (e.g. Kapp, 1970). As related ideas were taken up by other institutional economists, it was obvious to try to develop research programmes inside the framework of ecological economics.

Then what could an institutional perspective bring to the study of environmental issues? As institutional economics has led a life as an undercurrent in relation to mainstream economics, there is a strong tradition for developing critical perspectives towards mainstream work. This was also taken up as the first task in relation to the environmental field (see e.g. the article by Jacobs, 1994). As Spash and Villena (1998 p. 26) put it: "Unfortunately, there has been a tendency for the institutional literature to centre upon presenting criticisms of the neo-classical approach, rather than suggesting constructive alternatives"; however, in recent years the constructive part has received more attention.

Valuation was a dominant issue in environmental economics and an obvious target for critique—and a field where constructive alternatives could be provided. The outline of the institutional perspective above provides a direct basis for critical assessments of cost–benefit analysis and contingent valuation in relation to environmental issues: many relevant factors cannot be quantified or measured in terms of prices, and furthermore prices basically reflect historical and existing power structures; value monism does not make sense; marginal values should not be confused with total values; decision situations should be illuminated with all their conflicts instead of suggesting simplified 'solutions'; fundamental moral dilemmas should not be passed over; cost–benefit analyses tend to be used for policy justification and to relieve policy makers from responsibility by hiding behind technical calculations. As decisions must be taken, and valuation is unavoidable, the core task is to suggest alternatives that can support political decision making in a more acceptable way than cost–benefit analyses. Söderbaum's positional analysis was an early example of such an alternative, and in recent years multicriteria analysis and deliberative approaches have received much attention from ecological economists (e.g. Munda et al., 1994).

In relation to the ecological economic research in this field (e.g. the EVE project summarized in Spash and Carter, 2001 and the VALSE project summarized in O'Connor, 2000, introducing a special issue of Ecological Economics), a number of more specific points have been made, of which I will mention a few.

[4] This is not meant as a critique of using energy to measure the scale of the economy—it is only a critique of using energy as a measure of value.

Firstly, valuation is an on-going process in society, and social institutions determine the types of values that can be expressed in the public debate and in political decision making. These processes are important to expose. Secondly, as values are socially constructed and contextual, organized processes of valuation tend to shape people's preferences—values are not just present, waiting to be 'discovered'. Therefore, it is important to develop institutions for valuation that are open for multiple perspectives and allow the open expression of ideas, including public concerns and lay knowledge. Thirdly, it is important to avoid commodification of all entities in environmental valuation, because this tends to reduce both the complexity of the issue and the recognition of wider conceptions of value, including the intrinsic value of Nature, rights, justice and emotions. This has also been emphasized by Martinez-Alier (2002), who applies the term 'different languages of valuation' in relation to his research on environmental conflicts in developing countries.

Valuation is not the only field where socio-economists have contributed to ecological economic research. There have been many contributions in relation to the controversial issues mentioned above in relation to the identity work of ecological economics (trade, technological change, quality of life etc.). Furthermore, new issues emerge, such as the research on consumption and environment (e.g. Reisch and Røpke, 2004). One of the most important points in relation to socio-economic research is that environmental problems relate to broad social issues—they cannot be dealt with by environmental policies alone, but have to be considered in relation to all policy fields. Environmental problems spring from basic social structures and cultural understandings, and political strategies have to be equally wide ranging.

As mentioned previously, the research related to the ecosystem programme has also dealt with valuation. The obvious focus of this programme has been valuation in relation to ecosystems. As Perrings (1997) notes, the resilience perspective implies that the costs of, for example biodiversity loss cannot concern individual species or habitats, but must necessarily focus on ecosystems. It is noteworthy that "Most ecologists would argue that ecosystem services and support are essential for society irrespective of whether or not they are perceived as important by humans" (Folke, 1999 p. 907). However, this has not deterred researchers from trying to assess the economic value of ecosystem services based on contingent valuation. The awareness of uncertainty implies that adherents of this programme try to take, for example threshold effects into account, although this can be difficult to combine with traditional neoclassical methods. Most studies have been assessments in monetary terms, but some have supplemented with values based on energy analysis—another form of value monism. Arguing for the relevance of this approach, the adherents emphasize "All decisions concerning the allocation of environmental resources imply the valuation of those resources... We can choose to make these valuations explicit or not" (Costanza et al., 1997b, Introduction Section 5). This argument seems to imply that the only possible form of valuation must be based on value monism and has to be dealt with by scientific experts, and therefore, we must try to make such assessments as good as possible. This way of thinking is at odds with the socio-economic perspective of incommensurability, which emphasizes the basically political character of environmental decision-making, the importance of social conflicts and the need for developing social institutions to handle these conflicts. Some of the differences between different valuation perspectives are highlighted in the controversy sparked by the paper by Costanza et al. (1997) estimating the total global value of ecosystem services (Ecological Economics, 1998a,b, 25:1).

In the early days of modern ecological economics, before its formal establishment, another discussion on valuation played a more important role. Related to energy studies two questions were raised: (1) Should goods be valued according to the direct and indirect energy that has been used to provide them, how much should be included in the energy calculations, and how should these be done in practice? (2) Is it possible to find a positive empirical correlation between energy use and prices? Different energy theories of value have been discussed, but they have few defenders today, and they were not central to the discussions in the 1990s. However, the low priority of energy theories of value does obviously not imply that energy studies are not an important part of ecological economics. On the contrary, energy issues are central to discussions on the overall scale of the human

economy, multi-scale descriptions of economic processes and assessments of efficiency (e.g. Giampietro and Mayumi, 2000).

6.4. Tensions

From the above presentation of different research programmes it is obvious that ecological economics spans different tensions—transcending more specific controversies. These tensions are complex and cannot easily be reduced to simple opposites, but I will try to outline some of their aspects. A recurring discussion concerns the relationship between ecological economics and neoclassical economics; this I will use to illustrate the complexity of agreement and disagreement.

As far as I can assess, all researchers who somehow identify themselves with ecological economics still share the core beliefs that are outlined in Section 3. This implies a shared interest in coping with the serious global environmental situation and the related distributional problems. However, the perspectives regarding how academics in practice contribute to the much-needed global change differ at a basic level. Some (mainly economists) see ecological economics as a contribution towards changing the discipline of economics in a radical way: ecological economics is "economics done properly" (is Mick Common's expression, personal communication) based on the acknowledgement of the embeddedness of the economy in nature and society. This implies a clash with the dominant paradigm of neoclassical economics, which is seen as basically blind with regard to both nature and society. The abstraction from nature's life-support functions and from social power relations, the view of human motivations, the focus on optimality, and the abstract modelling exercises constitute a basically distorted worldview. The present dominance of the neoclassical paradigm contributes to the legitimization of policies that are seriously detrimental to the poor and destroy ecosystems and life conditions for other species to serve the short-term interests of the richest fifth of the world's population. Therefore, it is an urgent task for academics to undermine and uproot the basic understanding that allows such legitimization, and it is decisive to provide alternative understandings for new generations, not least in relation to the education of economists (sharing to a large extent the programme of the movement for post-autistic economics, see www.paecon.net). As this task has a long time horizon and will entail deep conflicts, the adherents of the perspective also try to influence present policies, but they try to do so without compromising their long-term ideas.

In contrast to this view others (mainly natural scientists) look for more immediate influence on the political agenda, concentrating on core messages regarding the seriousness of the environmental situation and trying to come up with illustrative numbers. To give weight to these messages it is important to form alliances with influential academics and to attract many members to the society. When some influential neoclassical economists are aware of the seriousness of environmental problems and support at least some of the messages of ecological economics, they are natural allies and their view can carry more weight than the view of relatively marginalized economists outside the mainstream ("If you can convert the pope, you have made a big step", as Daly describes this way of reasoning). From this perspective it is not so relevant what neoclassical economics can be used to legitimize in other contexts, and some would take a step further and argue that the socio-economic critique of neoclassical economics is a gross exaggeration. Actually, a general critique of neoclassical economics is sometimes seen as outright counterproductive, because it tends to isolate ecological economics as a marginalized sect and to scare away both the influential economists and the large number of potential members who could fill the ranks of the society. This approach tends to apply a consensus perspective, based on the belief that rational arguments have a strong persuasive power.

For some ecological economists with a natural science background, a positive attitude towards neoclassical economics also originates in shared methodological perspectives. Neoclassical economics is the social science discipline that has most intensely tried to copy the natural science use of abstract models and the language of mathematics, so the shared focus on modelling can facilitate communication. For economists, the use of mathematics functions as a kind of initiation test, and mathematical modelling tends to become synonymous with rigorous thinking. This contrasts with socio-econo-

mics where the use of quantitative modelling is less widespread and qualitative methods borrowed from sociology and anthropology are more common—methods that often seem unscientific to mainstream economists and natural scientists, who also often share an aversion to the idea that values are always with us. However, the methodological affinity between neoclassical economics and the natural sciences does not go unquestioned. Natural scientists are typically critical towards a science where empirical results cannot challenge the central hypotheses—and the core of neoclassical economics is immune to testing [this peculiarity of economics is emphasized by Whitley, 2000 (1. ed. 1984), whereas Coats, 1984 argues that Whitley overstates the coherence of and control exercised by the theoretical core]. Both Bob Costanza and Carl Folke emphasize that economics as a discipline changes slowly because of the lack of testing (personal communication). Furthermore, neoclassical economics is unaffected to a large extent by the changes in physics and biology away from reductionism as the only guiding principle (Gowdy and Erickson, in press). From this perspective ecologists and other natural scientists have more in common with socio-economists, who focus on qualitative change, path dependency and co-evolution—actually, the similarities are striking when comparing the outlines of the resilience perspective and the socio-economic perspective in Section 6. As some ecologists and other natural scientists are actually positive towards qualitative methods and the inclusion of social and cultural aspects etc., cooperation does happen with socio-economists both in ecological economics and in common property studies.

The cooperation between natural scientists and neoclassicists is probably encouraged by the fact that it improves the chances of recognition in different reputational organizations. Although ecological economics has established its own reputational organization, most researchers depend on having their research accepted elsewhere in order to have a reasonable number of publications and to get finance. The stronghold of neoclassicists in the review processes for journals and research funding implies that individual survival strategies are better served by cooperating with mainstream people than with more marginal groups.

Apart from the tensions concerning the relationship with neoclassical economics, there are also other tensions. Below, I have summarized some of the more important disagreements, as they are reflected in the broader discussion on how to delimit ecological economics and what the perspective of the development of the field should be:

- As already mentioned some want to develop ecological economics into "economics done properly" or see ecological economics as "the only heterodox school of economics focusing on both the human economy as a social system, and as a system embodied in the biophysical universe" (Gowdy and Erickson, in press). This perspective leaves very little room, if any, for neoclassical contributions inside the framework of ecological economics, whereas others are happy to include neoclassical contributions.
- Everybody agrees on the need to promote a transdisciplinary mindset in ecological economics. Some suggest using transdisciplinarity as the defining characteristic of the field, so all transdisciplinary studies on environmental issues could be said to belong to the field—whether or not they have any relation to the economics discipline (Proops, personal communication). This view is basically critical towards the preoccupation with reforming disciplines, whereas others find the use of transdisciplinarity as defining characteristic far too broad and meaningless.
- Some give priority to integrated ecological economic modelling and assessment as the culmination of the development of ecological economics to date, whereas others emphasize socio-economic studies, unequal exchange etc. Such differences are reflected in the different choice of topics for, on the one hand, the collection The Development of Ecological Economics (Costanza et al., 1997b) and, on the other hand, the introductory texts on ecological economics by Martinez-Alier (no year) and Söderbaum (2000).
- Some, in particular environmental economists, leave room for ecological economics as a subfield of environmental economics, dealing with the importance of life-support functions for the economy and the modelling of relations between ecosystems and the economy. Others find this a

totally unacceptable reduction of ecological economics.
- Some focus on ecology as the point of departure and describe ecological economics as the field emphasizing the link between ecology and economics, just as the field of ecosystem health emphasizes the link between ecology and medicine. Others do not want to give priority to ecology as being the most important natural science for ecological economics to link up to—the links can be to any natural science depending on the concrete project (Clive Spash, personal communication).
- Some give a high priority to the attraction of more natural scientists to ecological economics (see e.g. the call for papers for the Montreal conference in 2004), whereas others are not so alarmed by the social focus of the field.

As mentioned, these tensions cannot easily be organized into simple contrasts. Nevertheless, some have been reflected at the organizational level, to which I turn in the next section.

7. Organizational development

The society had a flying start as it was established simultaneously with the publication of the Brundtland Report and the second wave of public and political interest in environmental issues, as described in Section 4. As can be seen from Table 1, the conferences immediately attracted a large number of participants, and the conference in Costa Rica in 1994 became a mixture of an academic conference and a popular event also attracting a large number of practitioners in the environmental field. The membership rose very quickly to more than 1600 members, and in the mid-1990s a number of regional societies were established (see Table 2).

For many years, Bob Costanza was the undisputed leader of ISEE, being both the president of the society until 1998, when he was succeeded by Dick Norgaard, and the editor of the journal until 2002, when Cutler Cleveland took over. Costanza put a lot of work into the development of the society, and he succeeded in attracting much money from foundations to finance the activities, including conferences, workshops, publications and a bulletin with more accessible and policy oriented material than the journal. Costanza also established the Institute for Ecological Economics at the University of Maryland and headed a research programme at the Beijer Institute—altogether he made impressive efforts to ensure the impact of the field. Most of the original group of initiators of ISEE were happy with Costanza's commitment and leadership, but as described in Section 5, ISEE attracted a large group of socio-economists who were more sceptical towards the strategic line laid out by Costanza. Whereas

Table 1
ISEE membership and conferences

Year	Membership	Place of conference	Conference participants	Source of information
1990	Less than 300	Washington D.C., USA	Over 370	Members (in 1989): Editorial in Ecological Economics Vol. 9, No.1. Conference: Costanza, 1991 p. xi
1992		Stockholm, Sweden	Over 450	Jansson et al., 1994 p. xv
1994	Over 1600 from 60 countries	San José, Costa Rica	Over 1300	Costanza et al., 1996 p. ii and p. xxi. Same inf. on membership in van den Bergh and van der Straaten, 1994, p. ii
1996		Boston, USA	About 800	Cutler Cleveland, personal communication
1998	1617	Santiago, Chile	7-800	Members: Table 3. Conference: Osvaldo Sunkel, personal communication
2000		Canberra, Australia	376	List of participants, own count.
2002	1524	Sousse, Tunisia	About 350 plus informal participants	Members: Table 3. Conference: Martin O'Connor, personal communication
2004	2407	Montreal, Canada	568	Members: Table 3. Conference: List of participants on website

Table 2
Regional societies

Year of establishment	Regional society	Membership March 2004
1992/93	Russia (Russian SEE)	169
1994	Brazil (EcoEco)	689
1994	Canada (CANSEE)	70
1995	Australia and New Zealand (ANZSEE)	111
1996	Europe (ESEE)	384
1999	India (INSEE)	360
2000	USA (USSEE)	521

Note: Recently established regional societies in Argentina/Uruguay, South Korea and Sri Lanka are not included in the table, as they have very few members.
Sources: ISEE website, websites for regional societies, Newsletters from ISEE.

Costanza adhered to the "immediate influence-line" and had a relatively positive attitude towards contributions from neoclassical economics, the socio-economists were much more critical towards neoclassical economics and wanted to promote this view as a defining characteristic of ecological economics. The conflicts also tended to have a geographical dimension, as most of the active socio-economists were European and were frustrated over what they perceived as the American "ownership" of the international society. The late establishment of a regional society in the United States in a period when a number of other regional societies were established was interpreted as illustrative of this "ownership" idea. Costanza argues that this was merely the result of the difficulty of finding someone willing to do the work.

The conflicts were reflected at the organizational level, as the socio-economists wanted more influence, which was difficult to get because of the formal structure of the association. As the academic world is populated by persons with strong egos, the conflicts became quite fierce and were sometimes visible to the ordinary members participating in the business meetings. Watching the battles from the sidelines, some of the more pacific members found the critique of the committed Costanza and sometimes the older members of the leadership unacceptable, while they also found it difficult to understand why Costanza seemed reluctant to adapt to the demands for a more democratic and balanced organization. Costanza argues that he was very willing to democratize, but he found that the opposition did not understand the problems related to the funding of the society and accordingly would endanger the membership increase. The conflicts were detrimental to the society, but the identity of the field was strong enough to withstand them, and the ability of the icons (Daly, A-M. Jansson and Martinez-Alier) to remain apart from the conflicts contributed to the continuing unity. Over time the constitution has been changed, and the more frequent change of leadership can allow more balance. However, the conflicts are still smouldering, as illustrated by some of the changes of the editorial board of Ecological Economics in connection with the change of editor in 2002, where some of the socio-economists were weeded out (whereas the geographical distribution was almost the same); the most striking example was the exclusion of Clive Spash, who had been a member of the board for only a relatively short period (so the explanation given at the time which related to the need for rotation was a bit odd). The academic merits of Spash are unquestionable and, furthermore, it makes good sense to 'recognize' persons who are doing hard organizational work (in this case as the president of the European Society) by making them members of editorial boards (obviously, on condition that they are qualified).

The recent ISEE conference in Montreal (2004) could seem to illustrate that the current balance in the society is in favour of increased cooperation with neoclassical economists. Most strikingly, the Kenneth Boulding Prize was given to Partha Dasgupta and Karl-Göran Mäler, who are neoclassical economists with a central position in mainstream environmental and resource economics. Mäler is the director of the Beijer Institute (cf. Section 5), and in his speech of thanks he called attention to the fact that the majority of the plenary speakers at the conference have been actively involved with the Beijer Institute. Mäler interpreted this as an illustration of the importance of the Beijer Institute for the development of ecological economics; however, it could also reflect a bias in the choice of plenary speakers. At the business meeting of the society the Prize was a hot issue (for the first time[5]),

[5] Previous recipients of the Boulding Prize were Daly and Goodland in 1994, Costanza in 1996, Jansson in 1998, Holling in 2000, Ayres in 2002.)

emphasizing that more critical views regarding neoclassical economics are still thriving.

Despite different views and conflicts, the organization has been successful in spreading ecological economic ideas; several members have been active in establishing book series, introducing courses in ecological economics, providing teaching material and establishing publication outlets, also in journals other than Ecological Economics. Recently, textbooks have appeared in the field (Edward-Jones et al., 2000; Daly and Farley, 2004), and one more is underway (Common and Stagl, in press).

From the late 1990s the composition of the society began to change dramatically, as illustrated in Table 3. In several industrialized countries membership of the society fell in the period from 1997/98 to 2001/02; however, the recent trends have been more mixed.

Table 3
Number of ISEE-members in different countries

Countries[a]	1997–1998	2001–2002	March 2004
Argentina	15	11	5
Australia	121	98	94
Austria	11	20	26
Brazil	85	288	689
Canada	73	55	70
France	52	25	26
Germany	79	64	68
India	11	162	360
Italy	28	18	17
Japan	19	20	19
Netherlands	29	25	22
New Zealand	15	13	17
Portugal	12	8	16
Russia[b]	13	1	158
Spain	31	19	46
Sweden	30	21	16
Switzerland	27	20	14
UK	65	52	76
USA	708	462	521
ISEE total	1617	1524	2407

Sources: Own count on the basis of ISEE Membership Directory 1997–1998 and 2001–2002. In the introduction to the 1997/98 directory, the number of members is stated to be just under 2000 from 81 countries, whereas my count gives 1617 members from 70 countries. In the introduction to the 2001/02 directory, the number of members is stated to be approximately 1200, below my count of 1524. For 2004: the website of ISEE, membership service.

[a] The table includes the countries where the number of members has been 15 or more at any point of time.

[b] The two first numbers for Russia are obviously inaccurate, as the regional society has had more members since its establishment in 1992/93.

Probably, several factors have had an impact on these changes: the generally declining interest in environmental issues; the increasing competition from other associations dealing with environmental issues, as described in Section 5; and not least, the differences in the recent trends between countries also reflect the importance of personal efforts and ability with regard to recruitment. Simultaneously, the membership rose quickly in India and Brazil, partly as a response to the easier access with low subscription rates for members from developing countries and co-membership of the regional and the international society. It will be interesting to see how these changes influence future research programmes and scientific priorities. Currently, the changing composition of membership is not reflected in the composition of the editorial board of the journal, which is completely dominated by members from industrialized countries.

8. Concluding remarks

The preceding outline of different cognitive, social and organizational trends in the development of ecological economics provides the basis for considering the character of the reputational organization of the field. The concluding remarks thus return to the questions raised in the theoretical Section 2 and I try to answer them briefly. Simultaneously, the future prospects of the field are considered.

Firstly, the *knowledge structure* of the field as such is obviously not well structured and systematically organized. On the contrary, the field is programmatically open, pluralistic and transdisciplinary, so virtually unrelated contributions can appear as parts of the field. The core beliefs provide a framework for research, but they give little specific guidance. The foundation of the field was established by some core contributions that were mainly theoretical or historical [Georgescu-Roegen, 1971; Odum, 1971; Daly, 1977; Martinez-Alier, 1990 (first ed. 1987), Holling, 1973], and theoretical controversies have been important for the further development of the field, but most of the work is empirical and concerns specific topics. In general, the functional dependence is low, and the degree of both technical and strategic task uncertainty

is high. However, I have argued that a number of more specific research programmes can be identified, and within some of these programmes the degree of functional dependence is higher, the task uncertainty lower, and it is easier to specify what does and does not count as new knowledge.

Secondly, the *identity* of the field is relatively weak. There is a large group of researchers who identify with the field and share the core beliefs. However, these researchers do very different kinds of research, and most of them have "double identities" (or more than double) and also relate to other reputational organizations. The field has no clear boundaries in relation to other fields, and researchers from other fields can easily provide contributions that are considered relevant. Whether the field should have clearer boundaries is highly contested, as is the way in which they should be defined; researchers from related fields, such as environmental economics, also intervene in this definition struggle. Regarding the *reputational autonomy* of the field, it can be argued that the field has some control over its own competence and performance standards as well as over the relative importance of different research problems and strategies through the journal, other publications and conferences. But this does not carry much weight as the standards and priorities are contested inside the framework of the field, and as most researchers are also dependent on acknowledgement from academics from other fields (in particular from the old disciplines) to obtain research funding and establish a career.

Thirdly, the *internal organization* of the field is characterized mostly by flat structures, but also by having some hierarchical elements. The flat structure relates partly to the scientific openness, which gives the individual researcher much freedom to choose subjects and good chances of having research results published, and partly to the possibility for active and committed people to build up local activities under the heading of ecological economics. The reputational organization of ecological economics could and still can be used as backing for local initiatives, which have been more or less successful as reflected in the number of members in different countries. The local activities imply that large national differences in priorities, activities and composition of scientific disciplines represented have developed, although modern ecological economics was first institutionalized as an international society. The strategic dependence is thus low, but simultaneously the international society has, and in particular had, hierarchical elements with power concentrated on relatively few people, which is particularly important in relation to the journal and other publication outlets.

Fourthly, the *institutionalization* of the field has been successful at the organizational level with both international and regional societies with a large membership. The field has its own journal, which has been successful regarding ranking and number of issues. However, for several of the core representatives of the field (the middle-aged generation) it has been (more) important to publish elsewhere. In a sense this can be said to promote ecological economics by making central ideas known, but it is also illustrative of the need to relate to other reputational organizations. The field can boast of some dedicated research centres, educational programs and Ph.D.-programmes, but these are still few, and most of the researchers in the field are part of groups with broader commitments, where research and training in ecological economics form a minor part of the activities. The field does not monopolize the education of professionals for any specific labour market, but contributes together with several other fields to the education of professionals for a diverse range of positions related to environmental tasks.

Fifthly, the *relations to the outside world* are very diverse between countries. Sources for research funding differ—in some countries foundations are important, whereas public funding is more important in others. In Europe, EU funding has been decisive for ecological economic research. Ecological economics has benefited from research programmes directed towards transdisciplinary research; however, these possibilities are still restricted by the dominance of discipline-oriented researchers in the reviewing process (as noted by Perrings in the Dec. 2003 Newsletter of ISEE). Much research in ecological economics has a wider audience than scientific peers, as the results are sometimes addressed to central or local authorities, for instance, in relation to the conceptualization of the scale problem (for instance, materials flow analysis has influenced the European Environment Agency and Eurostat, and the resilience concept was included in the Swedish contribution to the Johannesburg meeting), the management of environmental

resources, decision-making processes and institutional change. Some research is addressed to and used by non-governmental organizations, such as the research on ecological footprints, environmental space, and ecological conflicts in the developing countries. In the USA, there is a tradition for cooperating with activists, and the conferences include talks by, for example journalists. Audiences outside academia can influence the reputations of the individual researcher, as most ecological economists consider it important to actually influence the political agenda.

Overall, modern ecological economics is, in many ways, a success story about the establishment of a new scientific field.[6] However, it is also a vulnerable success, and it is far from obvious that the field will survive the turbulence and the shifting priorities in academia. Other reputational organizations are competing for different groups of researchers who now form part of ecological economics, and the inner tensions of the field can undermine the present strength. One risk is that the field becomes uninteresting as a field, if identity is lost by the acceptance of anything as being justified because of transdisciplinarity. Some common ground is necessary to have interesting communication and to learn from each other. Another risk (others would call it a chance) is that the field loses its bite and becomes a sub-field of neoclassical environmental and resource economics modelling links between ecosystems and the economy. In my opinion, both would be a pity. The present geographical spread of ecological economics opens possibilities for getting wider support for the core beliefs of the field, and to meet this challenge some common ground as well as independence from neoclassical economics will be necessary.

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[6] I have not introduced the specific concepts used by Whitley (2000) in his typology to characterize the different types of fields. For readers familiar with the typology it will come as no surprise that ecological economics best fits the category 'fragmented adhocracy'. Ecological economics thus has much in common with management studies (Whitley, 1984).

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